CHAPTER 3: AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

3.1 Introduction

This section combines information that is often found in the "Affected Environment" and "Environmental Consequences" sections in other NEPA documents. It provides a detailed environmental analysis of four of the alternatives discussed in Chapter 2. For each of the general elements of the environment of the existing or baseline conditions of the affected environment are described. Both the effects on the environment and the proposed mitigation measures for each alternative are identified and discussed relative to the baseline conditions. For the purposes of this discussion the terms "effects" and "impacts" will be considered synonymous with consequences, and consequences may be positive or negative. The four alternatives are:

Alternative A-1: Partition the property into approximately 14, 20-acre parcels, and sell as rural residential/agricultural tracts, and continue to process imported material at the site until suitable raw material is no longer available.

Alternative A-2: Mine the property without an ITP approximating the 1998 site plan application submitted to Clark County and avoid take; partition the property into 7 to 10 rural residential home sites after reclamation. Continue to intermittently process sand and gravel on the site until existing onsite reserves and/or suitable offsite raw material is no longer available for import.

Alternative B: Mine, process sand and gravel, and undertake habitat enhancement and reclamation activity at the Daybreak property implementing the final HCP - Preferred Alternative.

Alternative C: Mine, process sand and gravel, and undertake habitat enhancement and reclamation activity at the Daybreak property following a design and conservation measures presented to the Services in July 2000.

A summary of environmental impacts is included in Table 3-1, below.

TABLE 3-1

Summary of Impacts*

Impacts	Alternative A-1	Alternative A-2	Alternative B	Alternative C
Soil	Varied	114 acres excavated	101 acres excavated	105 acres Excavated
Surface Waters Quantity	60 acres	89 acres created + 60 acres existing = 149 acres	Reconfigure existing ponds at 38 acres + new reclaimed ponds at 64 = 102 acres.	Existing ponds reclaimed at 60 acres + new ponds reclaimed at 73 acres = 133 acres.
Surface Water Quality	Existing ponds to be used for treatment as at present; discharge to Dean Creek/EFLR to be governed by current NPDES permit. Pollutants likely to enter EFLR from runoff from residential/agricultural tracts.	Existing ponds to be used for treatment with additives as at present; discharge to Dean Creek/EFLR to be governed by current NPDES permit. Limited potential for polluted runoff from 7-10 smaller residential development sites.	No pollutants from development; closed-loop treatment system to be installed to treat process water will almost eliminate turbidity related to operations in existing ponds.	Continue existing additive enhanced treatment system and installed closed-loop system within 3 years of ITP.
Ground Water Quality and Quantity	Insignificant	Insignificant	Insignificant	Insignificant

Impacts	Alternative A-1	Alternative A-2	Alternative B	Alternative C
Valley-Bottom Forest	Potential disturbance from residential/agricultural development by subsequent property owners	Varied with approximately 4 acres lost and 4 acres reserved + approximately 97 acres restored = 101 acres	8 acres reserved + 106 acres created = 114 acres.	8 acres reserved + 104 acres created = 112 acres.
Forested and Emergent Wetland	Approximately 2 acres reserved and 4 acres created.	Approximately ¼ acre removed and 25 acres reserved +25 acres created = 50 acres	¼ acre removed with 25 acres reserved + 59 acres created = 84 acres.	¼ acre removed with 25 acres reserved + 30 acres created = 55 acres.
Riparian	No impacts likely by residential/agricultural development; no enhancement	Riparian area along east bank of Dean Creek enhanced and a berm constructed within 50 feet to prevent avulsion into new ponds.	A 75-foot floodplain terrace and enhanced riparian area will be constructed along 1,385 feet of Dean Creek to recreate proper functioning conditions.	A 75-foot enhanced riparian area along 1,385 feet of Dean Creek with a berm in the outer portion of this swath to prevent avulsion of the creek into the created ponds.
Pasture/Agricultural Land	Varied depending on final rural residential use.	114 acres lost with potential additional depending on rural residential uses.	178 acres lost.	178 acres lost.

Impacts	Alternative A-1	Alternative A-2	Alternative B	Alternative C
Covered Species	No enhancement for covered species proposed.	Limited Dean Creek enhancement for covered species proposed. Ponds and wetlands for acclimation and put-grow-take fishery.	2.4 acres enhanced riparian habitat along Dean Creek and multiple activities in the creek channel to improve habitat for salmonids; varied amounts along the lower E. Fork of Lewis River.	2.4 acres of enhanced riparian habitat along Dean Creek and multiple enhancement activities in the channel to improve salmonid habitat.
Recreational	Recreational access limited by private rural residential development ownership.	Very limited access for fishing and hunting during mining; post mining access limited by rural residential development ownership.	Limited access for fishing and hunting during mining. Post mining, long-term access available for hiking and nature observation.	Limited access for fishing and hunting during mining. Post mining, long-term access available for hiking and nature observation.
Residential	14 residential tracts created	3 single-family homes owned by Storedahl removed. 7 to 10 tracts created for rural residential development.	3 single-family homes owned by Storedahl removed.	3 single-family homes owned by Storedahl removed.
Cultural	None	None	None	None
Visual	Rural residential tracts to be developed.	Mitigation to screen site from adjacent landowners during mining, with final rural residential development within the reclaimed area.	Mitigation to screen site from adjacent landowners during mining. Final use as open space with conservation easement.	Mitigation to screen site from adjacent landowners during mining. Final use as open space with conservation easement.

Impacts	Alternative A-1	Alternative A-2	Alternative B	Alternative C
Noise	None	Noise at neighboring residential properties mitigated to levels less than significantly adverse.	Noise at neighboring residential properties mitigated to levels less than significantly adverse.	Noise at neighboring residential properties mitigated to levels less than significantly adverse.
Air	None	None	None	None
Avulsion	Potential exists; protection measures likely to be hastily prepared in response to flood or erosion threats and likely to constrain and limit flood plain and riparian functions.	Potential exists; conditions would be monitored during mining operations and appropriate measures engineered and implemented to prevent avulsion event.	Existing ponds to be narrowed and forested wetland created to make most likely path "avulsion ready". Valley bottom forest planted to increase roughness and slow stream velocity in potential path. LWD placed in rows or debris jams to prevent avulsion with potential bioengineering or hydraulic techniques or structural controls implemented as necessary. Rapid response plan to assess potential take, assess the potential for redirecting flow back to channel, assess potential for enhancing or restoring salmonid habitat.	Conditions monitored regularly. If necessary, bioengineering or hydraulic techniques or structural controls would be implemented. Rapid response plan to assess potential take, assess the potential for redirecting flow back to channel, assess potential for enhancing or restoring salmonid habitat.

* A comprehensive boundary survey has not been completed and acreages are approximate based on computer aided drafting software calculations.

3.2 Physical Setting and Climate

The Daybreak site is located in Southwest Washington in Clark County within the valley of lower East Fork Lewis River. It is located at a transition point where the East Fork Lewis River emerges from a tightly confined canyon into an alluvial valley. This transition has resulted in the deposition of a relatively broad alluvial plain containing a large quantity of valuable high quality aggregate resources.

Climate at the Daybreak site is dominated by maritime influences of the Pacific Ocean, approximately 60 miles to the west, and its topographic location inland in the Willamette-Puget Lowlands near the Columbia River. Regional climate is characterized by cool, wet winters and mild, dry summers. Air quality is typically good in this rural setting dominated by agricultural uses and away from any significant industrial sources.

3.2.1 Topography--Affected Environment/Baseline Conditions

The project site is located in the relatively flat alluvial valley of the East Fork Lewis River (Figure 3-1). Surface elevations range from 30 to 60 feet above mean sea level (MSL). Natural slopes are less than 4 percent, but manmade slopes may be as high as 25 percent on the edges of ditches, road cuts, berms, and raw aggregate, sand or topsoil stockpiles. Before the area was developed for agriculture, the East Fork Lewis River in the vicinity of the project site was characterized by braided channels with extensive meanders and associated wetlands, as depicted on maps from 1854 to 1937. By 1951 the area was cleared, drained, and leveled for farming, primarily pasture (Collins 1997).

The 300-acre project site is directly north of the East Fork Lewis River, between RM 7.2 and RM 9.0. Past mining activities has resulted in approximately 80 acres converted to ponds currently permitted and used for process and stormwater treatment, mineral resource processing and stockpiles, and an access road. Of the remaining 220 acres, 200 are presently used as cultivated fields for crops and hay with patches of valley bottom forest, and 20 are being restored to forest. From river mile 16.8 to river mile 10.2, the East Fork Lewis River is confined to a narrow meander belt less than 1/4-mile wide (final HCP Technical Appendix C). Approximately 1 mile upstream of the project site, the East Fork Lewis River emerges from a tightly confined canyon into an alluvial valley that ranges from 0.5 to 0.75-miles in width. Valley sideslopes are approximately 300 feet high, with gradients of 30 to 40 percent. The river gradient in the project vicinity abruptly decreases near the site and bedload transported from the headwaters is deposited to a point about 1.25 miles downstream of the site providing spawning habitat for a number of salmon species. The river transitions to a flat tidally influenced finer grained sand and silt bed stream around river mile 6 just downstream of the project site (final HCP Technical Appendix C).

A small stream, Dean Creek, borders the Daybreak site to the northwest. During the summer, flow in Dean Creek along the upper corner of the property frequently dries up for significant periods of time from the J.A. Moore Road crossing for several hundred feet downstream. In this reach there is a significant buildup of gravel as the stream gradient flattens rapidly. For approximately 1,350 feet, the stream is adjacent to a cow pasture, and the banks are typically lacking in structure and mature vegetation due to historical livestock trampling and foraging. Downstream of this reach and off-site, the stream flows for about 0.5 miles through a series of beaver ponds and grassy wetlands and often lacks a defined channel.

3.2.1.1 Effects and Mitigation of Alternative A-1 on Topography: Partition the property into 20-acre parcels and sell as rural residential/agricultural tracts

<u>Effects</u>: Alternative A-1 would result in no mining of the site. Instead, the site would be converted into 20-acre tracts and sold for rural residential development and small farms. Little to no change in the existing topography would occur. The parcels most distant from the processing operation would be sold and developed first. Processing at Storedahl's existing operation would continue until off-site mineral resource supplies were exhausted and then the processing and aggregate storage area would be reclaimed and sold.

<u>Mitigation</u>: No mitigation other than reclamation of the existing mined ponds and the operations area per Washington Department of Natural Resources (DNR) requirements would likely be required under this alternative. Processing of imported raw material would continue with treatment of the process water including additives to minimize turbid discharges to levels well below the NPDES permit level.

3.2.1.2 Effects and Mitigation of Alternative A-2 on Topography: Mine with No ITP

<u>Effects</u>: Mining the subject property under this alternative is anticipated to result in permanent changes to the existing topography by creating a series of new ponds and wetlands totaling approximately 118 acres as a result of mining in those areas outside the 100 year floodplain. These areas are now occupied by the existing pastures, corn fields and the active restoration area between Bennett Road and the East Fork Lewis River. One small wetland would be created south of the entrance road, outside the 100-year floodplain, but in the CMZ. Processing of sand and gravel would occur under this altenative, with the ponds becoming incrementally, but not significantly, shallower as sediment is deposited in the existing ponds during the treatment process.

<u>Mitigation</u>: Mitigation measures for existing topographic effects under this alternative would be limited to a DNR mining reclamation plan. This plan would be developed, which would also be consistent with the requirements of the NPDES permit issued by the Washington Department of Ecology (Ecology) and various land development standards of Clark County, would be followed during the course of mining operations and used to guide reclamation of newly mined areas of the property. As part of the site reclamation

activities, areas adjacent to the existing mine ponds would be reinforced with structural erosion control measures, such as barbs, to control, prevent or minimize the potential for avulsion to occur within areas of the site being actively mined as proposed. A small berm would be installed approximately 40 feet from Dean Creek and mining would take place outside of that setback berm. As with all the active mining options, the property would routinely be inspected for signs of erosion, mass wasting, or other indications that structural reinforcement is required to prevent avulsion effects from occurring at the site.

3.2.1.3 Effects and Mitigation of Alternative B on Topography: Preferred Alternative

Effects: Contrary to the no-mining Alternative A-1, mining of the property under the preferred alternative would result in both temporary and permanent changes to the site's topography such that it would have conditions, for example, wetlands, valley bottom forest, oxbow ponds, etc., that would serve as diverse fish and wildlife habitat and make the property amenable for incorporation with the Vancouver-Clark Parks and Recreation Department East Fork Lewis River greenbelt plan. Mining would occur on approximately 101 acres of the subject property, outside the 100-year floodplain. The area mined would be slightly smaller than under Alternative A-2, as an area southeast of Bennett Road near Storedahl Pit Road (the entrance to the existing processing area) and some existing forested and forested wetland areas would not be mined despite its being outside the regulated floodplain.

Created ponds with reclaimed depths ranging from areas only a few feet to approximately 30 feet deep would occur as a result of the mining, reclamation, and habitat enhancement. Temporary changes would include the installation of haul roads to move gravel from areas where active mining would take place to the conveyor loading area or processing area. Temporary berms around an active mine phase, comprised of overburden material, would be planted with native, fast growing tree species to restrict visibility from the county road and neighboring properties. These berms would be removed as mining and reclamation is completed. Below the water table (which ranges between 2 and 12 feet across the site), reclaimed slopes would be finished at a 1.5:1 slope. Above the water table, reclaimed slopes would be set at a 2:1 slope.

Mitigation: To offset the topographical effects associated with Alternative B, portions of the excavated areas would be backfilled and sloped to provide habitat enhancement, including shallow marshlands and gentle slopes along the banks of the ponds. Additionally, small islands would be created in some of the mining ponds with backfill material and the margins between the ponds and Dean Creek would be developed and reclaimed as forested wetland. A forested floodplain terrace, as opposed to the berm associated with Alternative A-2, would also be created between the backfilled area and the current banks of Dean Creek. This would allow Dean Creek to overflow its banks and meander through created riparian habitat during flood events, instead of controlling the meander with the berm proposed under Alternatives A-2 and C.

The existing ponds would be significantly narrowed through backfilling and the creation of forested wetlands, transitioning into emergent and then open water wetlands to approximate a channel configuration that pre-dated Euro-American settlers. Pond 1 would be filled to make it shallower so that the pond bottom would be at an elevation that is approximately the same as the bottom of the adjacent East Fork Lewis River channel. This will eliminate the elevation difference between the channel bottom and the pond bottom and thus further reduce any potential for avulsion into the pond. Furthermore, in the event an avulsion did occur, filling the pond would minimize any potential for erosion along the upstream river channel. Temporary berms surrounding the site would be removed and the areas would be replanted with native trees that historically would have been found along the lower valley floor of the East Fork Lewis River.

A conservation easement covering the entire property, gifting the property to appropriate conservation minded entities and a $1million endowment for management in perpetuity would ensure maintenance of the reclaimed topography. In addition, Storedahl has agreed to post a bond to cover avulsion contingency upon initiation of the ITP, and to ensure that funds are available for appropriate responses to an avulsion threat, should it develop. The applicant has made a commitment to provide $25,000 per year over 10 of the 15-years of the life of the project to support riparian recovery efforts in the East Fork Lewis River basin. Depending on the results of these riparian enhancement efforts, topographic changes could also occur off-site.

3.2.1.4 Effects and Mitigation of Alternative C on Topography: July 2000 Draft HCP

<u>Effects</u>: This alternative would result in similar effects identified in Section 3.2.1.3 under the preferred alternative (B). The main topographical differences between the two alternatives include: 1) the proposed mining under Alternative C would affect 105 acres, as compared to of 101 acres under alternative B; 2) instead of a floodplain terrace, a setback levee adjacent to Dean Creek would be enhanced to confine Dean Creek, similar to Alternative A-1; 3) the existing ponds would not be reconfigured, partially filled and planted with wetland forest; 4) mining would occur southwest of Bennett Road, outside the 100-year floodplain; 5) lower East Fork Lewis River riparian area in-kind enhancement support would not be included; and 6) the $1 million endowment to manage the reclaimed property in perpetuity would not be established.

<u>Mitigation</u>: Similar to Alternative B, the topographical effects associated with the creation of ponds resulting from excavation would be offset by the creation of small wetland marshes along the banks of the ponds. Trees and shrubs would be replanted throughout the site, including along the setback levee and banks of Dean Creek. Terraced banks would be constructed to obtain the 75-foot setback proposed in the July 2000 HCP. Terraced areas would be stabilized with trees to prevent erosion and increase riparian habitat adjacent to Dean Creek.

3.2.2 Climate and Air Quality --Affected Environment/Baseline Conditions

The climate of the area is dominated by maritime influences of the Pacific Ocean and its topographic location inland in the Willamette-Puget Lowlands near the Columbia River. Regional climate is characterized by cool, wet winters and mild, dry summers. Over 80 percent of annual precipitation falls between October and April. During summer, a regional high-pressure system generally resides over most of the Pacific Northwest, which diverts storms and associated precipitation to the north.

This regional climatic pattern is modified by the presence of the Coast Range, which results in somewhat lower precipitation and greater temperature ranges than the coast region to the west. Although not having a major direct climatic effect on the project site, the influence of the eastward-lying Cascade Mountains on precipitation and snowfall patterns is important to the seasonal discharge patterns in the East Fork Lewis River.

The Cascade Mountains rise to an elevation of approximately 4,200 feet at the eastern margin of the East Fork Lewis River drainage basin. Snowmelt and spring runoff are major sources of water to streams, and rain-on-snow events can result in major floods.

At the Battle Ground climate station, approximately 4 miles southeast of the project site, temperatures range from an average July maximum of 78.1°F to an average January minimum of 31.4°F. Mean annual precipitation at Battle Ground is 52.3 inches, with snowfall averaging 7 inches a year (Western Regional Climate Center 1998).

3.2.2.1 Effects and Mitigation of Alternatives on Climate and Air Quality

Climatic changes are not expected to occur as a result of any of the alternatives discussed within this document. Similarly, air quality issues associated with the project site would be limited to what occurs at and is currently permitted by the Southwest Clean Air Agency for the existing processing area. Fugitive dust emissions are typically a concern at mining operations. Measures currently permitted include active watering of processing and haul roads and equipment to prevent fugitive dust particles from leaving the project site. With this measure, no changes in air quality would occur regardless of which alternative is utilized.

3.2.3 Geology and Soils--Affected Environment/Baseline Conditions

Geology

A detailed description of the geology of the East Fork Lewis River basin is provided in the final HCP. Near the project site, the river valley formed by the lower East Fork Lewis River cuts through a thick sequence of alluvial materials known as the Troutdale formation. The upper member of the Troutdale formation is primarily sand and gravel and the lower member of the Troutdale formation is primarily fine sand, silt and clay. This lower “silty” phase of the

Troutdale formation crops out along the East Fork Lewis River on the north side of the valley above the Daybreak Bridge as well as on the south bank across from the project site (Figures 3-2 though 3-4).

The valley floor is composed of alluvium dating from the Holocene to the present (Figures 3-2 through 3-4). The alluvium consists of gravel, cobbles, sand, and silt, and ranges in thickness from several feet to 50 feet at and near the project site. Gravel and cobbles are exposed in cut banks and on the river bottom in the immediate site area. Gravel bars are common in the river reach adjacent to the subject property, but they are conspicuously absent downstream in the tidal influence zone, where silt, fine sand, and clay predominate. The finer grained lower member of the Troutdale formation underlies the Holocene or recent alluvium of the valley floor.

The East Fork Lewis River channel typically ranges from 100 to 350 feet wide and averages approximately 4 to 6 feet deep at bankfull stage. The banks are typically comprised of non-cohesive materials similar to the sediments found in the channel bed (sand, gravel, and cobble). The rapid reduction in river gradient through the reach downstream of Daybreak Park reduces the sediment transport capacity of the river. The reduction in sediment transport capacity results in the deposition of sediments carried from upstream sources. The natural trend for sediment deposition along the river in the area results in a relatively high lateral migration rate, which tends to rework material that has been deposited in the past. In the reach downstream of Mason Creek, silt and sand are exposed on the riverbanks to heights of 5 to 8 feet above the river surface.

Soils

Soils in the upper East Fork Lewis River basin are generally deep, well-drained silt loams (McGee 1972). Soils formed on periglacial deposits adjacent to the lower river are deep, well to poorly drained silt and sandy loams. Soils formed on alluvium deposited by the East Fork Lewis River are generally excessively drained sandy loams underlain by gravely sand or loamy sand at a depth of 16 to 40 inches (McGee 1972).

The 1972 Soil Conservation Service (SCS) *Soil Survey of Clark County, Washington,* identified and mapped the following soils at the project site: Washougal loam (WaA); Washougal gravelly loam (WgB, WgE); Puyallup fine sandy loam (PuA); and cobbly Riverwash (Rc)).

The Washougal loam and Washougal gravelly loam soils consist of well-drained soils that overlie sand and gravels. Permeability in the units is rapid in the substratum and the surface runoff potential is low, making the erosion hazard slight to none. About 50 acres of Washougal loam and another 50 acres of Washougal gravelly loam with 0 to 8 percent slopes are found at the project site. There is also approximately 0.4 acres of Washougal gravelly loam with 8 to 30 percent slopes. The SCS classifies the Washougal loam as Capability Unit IIIs-1 and the Washougal gravelly loam as IIIe-3. Class III soil generally has severe limitations that reduce the choice of plants, require special conservation practices, or both. Fertility for both soils ranges from low to moderate.

Puyallup soils are excessively well drained and overlie sand and gravel of moderately rapid permeability (SCS). Surface runoff is low and there is no erosion hazard according to the SCS. Approximately 125 acres of the project site consists of Puyallup fine sandy loam. The SCS has assigned this soil type to the Capability Unit IIIs-1, indicating low to moderate fertility.

The project site contains about 40 acres of cobbly Riverwash, which consists of nearly level, recently deposited unconsolidated alluvium that is stratified and variable in texture. The SCS has assigned this soil to the Capability Unit VIIIw-1, which supports little or no vegetation and, according to the SCS, has no farming value. Fertility and water-holding capacity are low, and there is no erosion hazard.

While road development, mining and processing have occurred on approximately 80 acres of the site over the last 30 years, the remaining 220 acres of the project site have been used for low-intensity agriculture or remained in an undisturbed state. Agriculture has been limited to corn and hay production, and livestock pasturing associated with the dairy farm on the neighboring property across Dean Creek to the northwest. Hay and corn production continues on the site, with one or more hay cuttings per year. Because of the topsoil's inability to maintain adequate moisture content, hay and corn production generally requires irrigation during the growing season. The areas currently undergoing reforestation are also seasonally irrigated.

3.2.3.1 Effects and Mitigation of Alternative A-1 on Geology and Soils: Partition the property into 20-acre parcels and sell as rural residential/agricultural tracts

Effects: Agricultural activities would change under Alternative A-1. The existing hay and cornfields would be replaced by 20-acre tract rural residential development. Probable uses of the property would include housing, pastureland, and gardening. Construction of houses and outbuildings would increase the impervious surface area on the property, increasing stormwater runoff flows and, potentially, contributing to a minor increase in sediment transport into Dean Creek and the East Fork Lewis River. However, the high permeability of the soils and gravels at the site, as well as the relatively level terrain would limit potential soil erosion effects associated with this type of development. Some localized soil quality improvements would be expected as a result of the addition of soil amendments (such as fertilizers and mulch) into household gardens and pastures.

The main effects to geology and soils resulting from Alternative A-1 are expected to be short-lived and temporary in nature. Impacts would occur during construction and development of homes and outbuildings to house families and livestock. Because of the size of the lots that would be created, it is possible that individual landowners would choose to grow crops for personal use, as well as for sale in local farmers markets, resulting in exposed top soils and potential localized soil erosion control problems on each tract.

Mitigation: The applicant would not be in a position to adopt mitigation measures associated with subsequent building by purchasers of partitioned parcels. However, temporary erosion control measures to reduce off-site sediment migration during home and outbuilding construction would likely be controlled by energy dissipating structures, silt fencing, and straw bales in accordance with applicable local regulations. As described in FEIS Section 3.4.4.1, following development there would be an increase in impervious areas on the site, and there may be an attendant increase in stormwater runoff and consequently local erosional impacts. Landowners seeking to farm portions of their property may deal with yearly soil erosion concerns associated with topsoil exposure after spring tilling or fall harvest efforts. However, as noted in HCP Section 3.1.4.2, the site soils are highly permeable, and it does not exhibit steep slopes but is gradually sloping. As such, cover crops and other measures, such as the use of straw bale filters in outfall drains or mulching could be used to limit soil run-off from their fields. There are no local state regulations to require treatment of stormwater runoff from farm pastures or fields.

3.2.3.2 Effects and Mitigation of Alternative A-2 on Geology and Soils: Mine with no ITP

Effects: Under Alternative A-2, agricultural use of the land would be eliminated. Areas not planned for mining or for processing and stockpiling of sand and aggregate would be planted with native species to create upland forest. Topsoil and overburden material would be removed and stored in vegetated stockpiles in upland areas outside the 100-year floodplain and outside the most probable avulsion paths, similarly to Alternative C as shown on Figure 2-1, or used for temporary noise attenuation and sight obstruction berms in strategic locations on the project site. These stockpiles would be consumed during the sequential reclamation of the active mining phases in accordance with a reclamation plan, which would be prepared for approval by DNR.

Minor erosion and sediment transport effects associated with mining and processing operations may occur. However, the nature of the mining operations and the drainage characteristics of the site would limit the potential for erosion and sediment transport off-site. Erosion from disturbed areas in upland portions of the site is unlikely due to the high permeability of the soils and the relatively low velocity of flood flows in areas above the 100-year floodplain. However, there would be a smaller increase in impervious area and the area available for farming activities relative to Alternative A-1. Further, the transport of any eroded sediments through the spawning gravels downstream of the site would be rapid as explained in Technical Appendix C of the final HCP.

Under the proposed mining plan, surface erosion within any active excavation would also be self-contained. Erodible material would either settle to the bottom of the active excavation or be carried along with the excavated gravels into the processing area to be processed. Excavated mineral resources would be transported to the processing plant, and the resulting product would then be stockpiled until it is hauled from the site. As all drainage from the processing area is directed to existing Pond 1, which is the initial basin for stormwater and process water treatment, no off-site sediment transport in excess of that permitted by the NPDES permit is expected to occur.

Mitigation: Soil placement for reclamation would occur concurrently with the closure of each active pit on the site, thereby limiting the amount of erodible soils exposed at any one time during the course of the mining operations. Temporary berms comprised of the overburden materials extracted from each pit would be constructed at selected locations along the perimeter of the property to serve as visual and noise buffers. These berms would be seeded with native herbaceous and scrub/shrub material. Following completion of the mining activities, the temporary berms would be converted into permanent contoured buffers, which also would be seeded and planted as specified in the mine reclamation plan. Both measures would prevent any unforeseen erosion problems. Further, areas not mined, as well as the upland margins of the ponds resulting from the mining activity, would be planted with native valley bottom forest species to revegetate the site and reduce potential soil erosion.

3.2.3.3 Effects and Mitigation of Alternative B on Geology and Soils: Preferred Alternative

Effects: Agricultural use of the land would be eliminated. All areas not planned for mining would be planted with native upland forest species. Topsoil and overburden in mined areas would be sequentially removed and reserved in temporary stockpiles and berms around the project site. Upon completion of mining activities at each active pit, the topsoil would be removed from the stockpiles and/or temporary berms and used for site restoration activities, such as creating a growing medium for replanting the shallow marshes, wetland forest and emergent wetlands associated with the proposed ponds, and creating the floodplain terrace associated with Dean Creek.

As discussed in Alternative A-2 (mining without an ITP), erosion and off-site sediment migration is not anticipated due to the implementation of best management practices on the project site. Also similar to Alternative A-2, erosion from mining activities, and temporary topsoil and overburden stockpiles in upland areas of the site would be unlikely because of the high permeability of the soils and low-velocity of flood flows in areas above the 100-year floodplain. There would be no incremental increase in impervious area, as with Alternatives A-1 and A-2, and at the cessation of mining the existing impervious area would be significantly reduced due to the removal of structures, reclamation and habitat enhancement activities. Under Alternative B, an additional measure to further restrict sediment transport into adjacent creeks and streams would be implemented. To eliminate the deposition of silts, clays and fine-grained sands in the existing ponds from the untreated process water, Storedahl would implement a 'closed-loop' water treatment system that recycles water used for wet processing. Implementation of this 'closed-loop' system would eliminate the use of the ponds as the primary treatment system for the processing water. The ponds would be limited to treating stormwater runoff from the processing site and waters discharged from the ponds would meet or exceed the quality requirements of the site's NPDES permit.

Mitigation: Similar to Alternative A-2, upland forest native species would be planted in all areas not planned for mining and soil reclamation would occur concurrently as mining is completed at each proposed pit on the site, thereby limiting the amount of erodible soils exposed at any one time during the course of the mining operations. Temporary berms, comprised of the overburden materials extracted from each pit, would be constructed in selected locations to serve as visual and noise buffers. These berms would be seeded with native herbaceous and scrub/shrub material to prevent off-site soil migration and erosion from occurring. Following completion of the mining activities the temporary berms would be converted into permanent contoured buffers, or used for planting substrate along the pond perimeters, wetland forest and proposed shallow water areas. All areas would be reseeded, monitored, and maintained following initial restoration activities.

As part of the proposed HCP and as described in Section 3.4.4.3, Storedahl would implement a 'closed-loop' processing water treatment system under Alternative B thereby substantially eliminating the direct discharge of wet processing materials (fine sand, silt and clay) to the ponds. After dewatering, the accumulated fine-grained materials from the treatment system would be used for reclamation purposes, for example, wetland creation. The ponds would continue to act as the treatment system for site stormwater runoff, but pond volumes would be sufficiently large to effectively treat this runoff to ensure that water quality of the discharge would meet or beat the water quality requirements of the site's NPDES permit.

3.2.3.4 Effects and Mitigation of Alternative C on Geology and Soils: July 2000 Draft HCP

<u>Effects</u>: As discussed in Alternative A-2 (mining without an ITP), erosion and off-site sediment migration is not anticipated due to the implementation of best management practices on the project site. Also similar to Alternative A-2, erosion from mining activities and temporary topsoil and overburden stockpiles in upland areas of the site would be unlikely because of the high permeability of the soils and the low-velocity flood flows in areas above the 100-year floodplain. Under Alternative C, a permanent berm comprised of overburden materials would be constructed 75-feet back from Dean Creek and vegetated with native grasses and shrubs. On the opposite side of the berm, that is, away from Dean Creek, a 125-feet wide area would be backfilled and replanted as forested wetland following mining activities.

Additional measures to further restrict sediment transport into adjacent creeks and streams would be implemented. The direct discharge of process wastewater to the existing ponds would be discontinued. A 'closed-loop' processing water treatment system would be implemented that recycles water used for wet processing of materials. As with Alternative B, the dewatered sediments from the treatment system would be incorporated into the site reclamation, for example, for the creation of wetlands. Sediments in stormwater runoff from the processing site would filter out as water flows from pond to pond before entering Dean Creek. Implementation of this 'closed-loop' processing water treatment system, and use of the ponds as the treatment system for processing area stormwater runoff, would ensure that only waters meeting or exceeding the quality requirements of the site's NPDES permit would enter the watershed.

Mitigation: Alternative C would implement similar measures proposed for Alternative B with some variations. The extent of soil movement associated with pond reclamation would be reduced such that only 30 acres of wetland forest and shallow emergent wetland areas around the ponds would be created (versus 59 acres proposed under Alternative B).

3.2.4 Summary of Alternative Action Effects on Topography, Climate, Air Quality, Geology and Soils

All four of the Alternatives discussed would have some effect on topography, geology and soils and little effect on climate or air quality. Alternatives A-2, B, and C would all permanently change the topography and soils associated with the site. However, all three of these alternatives propose some forms of best management practices to control off-site soil migration and minimize dispersion of erodible soils into the East Fork Lewis River watershed. All three of these alternatives also provide mitigation measures to restore the area to emergent and forested wetlands and open water pond system interspersed within a valley bottom forest environment. Generally, the effects of all three mining alternatives would be similar with variations only in the area of mining and reclaimed wetlands or uplands. One notable difference is that Alternative B includes an endowment fund to insure that the mitigation measures are maintained in perpetuity and a bond to cover avulsion contingencies, whereas Alternatives A-2 and C do not.

Alternative A-1 does not substantially change the topography of the land, nor does it require substantial amounts of soil to be moved during the course of home or outbuilding construction. Alternative A-1 does not provide for total management of the entire site following partitioning of the property into individual 20-acre parcels, nor does it ensure that the site would be maintained in such a fashion as to prevent soil erosion from affecting the East Fork Lewis River.

None of the alternatives described herein would have any more or less effect on climate or air quality issues.

3.2.5 Analysis of Cumulative Effects of the Alternatives on Topography, Climate, Air Quality, Geology and Soils

Each alternative would result in a permanent change to the landscape and, therefore, the topography of the land. Effects of Alternative A-1 would be limited to grading for residential structures and roads, and perhaps more intensive agricultural activities, whereas Alternatives A-2, B, and C would all result in increased forested upland, emergent wetlands and open water ponds. However, Alternative A-2 would include 7 to 10 development sites for rural residential homes around or between the reclaimed ponds and wetlands. Alternative B would include reshaping and recontouring the existing ponds with added forested wetlands and reduced depths in the existing ponds. This activity proposed under Alternative B would facilitate returning the site to conditions that more closely resemble the habitat in place prior to Euro-American settlement than the existing pastures or possible development as low density residential land use. Such restoration would make the site conducive for inclusion in the open space greenbelt being acquired by Clark County and include an endowment fund to insure proper management of the property in perpetuity.

3.3 Floodplain

This section presents the historic and existing conditions of the East Fork Lewis River geomorphology in the vicinity of the project site and the dynamics associated with the river system. Included is a discussion of the hydrologic and regulatory floodplain, past avulsion events and potential for future events, followed by a description of the potential effects of each proposal and proposed mitigation measures.

3.3.1 Floodplain-- Affected Environment/Baseline Conditions

Floodplain

Geomorphology is the branch of geology that deals with the form of the earth and the changes that take place in the evolution of landforms such as floodplains, which are nearly flat areas along a stream or river that is historically and/or currently subject to flooding. Floodplains comprised of alluvial deposits typically form where rivers emerge from mountainous terrain onto more gently sloping lowlands. Floodplains are often bordered by steeper alluvial fans that form where smaller tributary streams emerge from valley sideslopes and deposit their own sediment before flowing across the floodplain to join the mainstem river.

The project site occupies portions of the alluvial valley formed by the East Fork Lewis River, and portions are located within the area mapped as the 100-year floodplain (Figure 3-5). Mining is proposed only in areas falling outside the 100-year floodplain designated by FEMA (Physical Map Revision) in a Letter of Map Revision on June 16, 1999 and as shown on FEMA Flood Insurance Rate Map Community Panel Number 530024 0178 C, July 19, 2000. Reclamation of the existing ponds would take place within the regulatory floodplain. Limited components of the processing equipment, such as portions of the conveyor system and process water intake structure and treatment facilities, would also continue to exist in the floodplain until final reclamation is complete.

There are several ways to describe the floodplain bordering a mainstem river. The geomorphic floodplain refers to the landforms constructed by the existing flow network over geologic time and includes the alluvial valley bottom and alluvial fans formed by lateral tributaries. The geomorphic floodplain does not include terraces formed by glaciation or by the Lake Missoula outburst floods, even if they are adjacent to the existing channel. A topographic floodplain includes land adjacent to the channel up to the elevation reached by a flood-peak with a given return frequency. Topographic floodplains are used to define the potential risk of flooding and to regulate land use or construction standards within communities. For example, under the National Flood Insurance Program (NFIP) administered by the Federal Emergency Management Agency (FEMA), the 100-year return period floodplain is used as the basis for communities participating in the NFIP program to regulate development and for FEMA to administer flood insurance.

The hydrologic floodplain includes the land adjacent to the baseflow channel that is inundated about two years out of three (USDA 1998). Presently, the hydrologic floodplain is mapped as the area inundated by the 2-year flow event, or within 80 feet (two times the average lateral migration rate of approximately 40 feet per year), of the existing low-flow channel (Figure 3-6).

The channel migration zone (CMZ) is defined as the area that the river has occupied in the last few years or decades and would reasonably be expected to occupy again in the near future (Washington Forest Practices Board 1997). For the purpose of this project, the CMZ was mapped as the area inundated by the 20-year recurrence interval flood, or within 800 feet (20 times the average lateral migration rate of approximately 40 feet per year), of the existing low-flow channel, whichever is less (Figure 3-6). The CMZ does not include ineffective backwater areas, as opposed to erosive currents, or intermittent overflow paths that cross roads or other man-made developments. This definition conforms to King County's[5] description of Mitigated Hazard Zones for channel migration. A Mitigated Hazard Zone is described as the unconstrained natural limits of channel migration scaled back to the boundaries of major roads, developed areas, revetments and levees (Perkins 1993). At the subject property, the CMZ does not include ineffective backwater areas such as the Daybreak ponds or intermittent overflow paths that cross roads or other developments.

Ineffective backwaters, such as the Daybreak ponds, were excluded from the CMZ as they are, by definition, locations that do not convey a significant portion of hydraulic flow and, in this instance, are separated from the river by existing roads and high ground outside of the 100-year floodplain. Intermittent overflow paths were excluded since they are above bankfull elevation, show no evidence typically associated with active side channels, and cross several county maintained roads. It is reasonable to expect that the existing county roads will be maintained and protected from erosion by the river, based on their use as public right-of-way, long history of existence and regular maintenance, use as regional arterial routes, and importance to the significant existing developments in the area.

[5] King County's manual is considered the authoritative guidance for preparing planning and development documents for Greater Western Washington.

Avulsion

Avulsion is a rapid and unexpected shift in channel position that causes a part of the existing channel to be abandoned and a new channel to be formed. Historically, in the project vicinity the East Fork Lewis River has been an actively migrating channel. Over geologic time, the channel has migrated from valley wall to valley wall in the reach encompassing the Daybreak Bridge, interconnecting county roads, the Ridgefield mining area, Daybreak ponds, and project site. In the recent past, the channel has tended to stay along the south valley wall. Maps and photographs show that the channel has migrated and shifted position several times along this reach. In the 1854-era maps, the channel is documented to have had a braided channel pattern, and was bordered by riparian wetlands along most of the lower 13 miles (that is, from the mouth to 13 miles upstream) (Collins 1997). Because of the limitations of historical data, for most of the period of record it is not known where avulsions, if any, took place. However, it is certain that significant channel shifting and abandonment have occurred (See Technical Appendix C, final HCP). Prehistoric avulsions were probably due to obstruction of the flow by debris jams or by the breaching of a natural levee that separated the river channel from a topographic low, such as a former channel.

In recent years, two instances of avulsion of the East Fork Lewis River have been documented. Each instance was associated with the migration of a river meander into ponds formed by gravel excavation areas that were close to the main river channel. The first documented avulsion involved the Mile 9 Pit in November 1995. The Mile 9 pit is located approximately one-half mile upstream of the Ridgefield mining area (Figure 3-6). This event resulted in the channel shifting to the south, abandoning approximately 1,700 feet of channel (Norman et al. 1998). The second documented avulsion involved the Ridgefield mining area in November 1996. The channel avulsed into the southeastern corner of the southern Ridgefield Pit 1. This changed the course of the river, which was formerly flowing north along the southern boundary of the project site. The channel currently flows through a complex of six pools formed by relict mining ponds (Figure 3-7). Approximately 3,200 feet of channel was abandoned when this event occurred (Norman et al. 1998). Since this time, the upper two pools have filled significantly with deposited sand and gravel, and the upper approximately 900 feet of the avulsed reach has naturally reclaimed to a shallow riffle with a connected off-channel pool (Figures 3-8 and 3-9).

Other minor avulsions or pit breaches were documented from examination of maps and aerial photographs. Between 1984 and 1990, the river migrated into the northeastern Ridgefield Pit 8. Although this did not cause the channel to change course, a connection was created between that pond and the main channel. Between 1990 and 1995, the river had entered the southeast corner of Ridgefield Pit 7, flowing back into the channel at its northernmost point. This caused the abandonment of approximately 1,500 feet of channel south of the project site. However, most of the abandoned channel remained submerged and connected to the main channel.

Neither the entry of the East Fork Lewis River into the Mile 9 Pit or the Ridgefield mining area was an unexpected shift in channel position. In both cases, a meander of the river migrated toward the ponds over time. In the case of the Ridgefield mining area, the river's migration into the ponds had been predicted several years in advance (Bradley 1996). The historical migration path of the river had been documented to be in the direction of the Ridgefield mining area for, at least, the past 60 years (Bradley 1996). The recent and current trends of channel migration are discussed in the following section, "Planform and profile analysis." Please also see HCP Section 3.3.1.3 and Section 3.3.2.2, and HCP Technical Appendix C Section 2.7.regarding past mining in the upper and lower watersheds, and avulsion in the lower watershed.

Planform and profile analysis

A planform analysis describes changes in the location of the river channel over time. A river profile analysis describes changes in the slope of the river channel over time. Planform and profile analysis conducted on the East Fork Lewis River are described in the final HCP Technical Appendix C. The results of these analyses are described below.

*Daybreak Bridge (River mile 10) to North Mill Creek (River Mile 9.2)***.** The planform analysis demonstrated that the river channel within this reach has moved very little since the survey of 1854-1858. The channel profile demonstrates that the river is relatively steep and shows only minor changes in bed elevation, except at the confluence with North Mill Creek. Deposition of sediment in the river channel over time within this reach could cause increased lateral migration. However, no obvious alternative flow paths exist that would allow the river channel to connect to the project site without destroying public roads, bridges, homes, and the Clark County shops located along the north bank of the river immediately upstream of the project site.

Minor overland flows may occur north of the river between sites A and B along this reach during major floods (Figure 3-10). The flow could enter the ponds created in proposed mining Phases 1C, 1D, 2A, 2B, 2C, 3 or 5 labeled on Fig 2-1 and cause erosion along the pond shorelines. However, overland flows along this path are expected to be, in general, non-erosive and are not considered to describe a potential avulsion path. In addition, the existing residential development, Clark County shop, and existing county roads (NE 269th Street, Bennett Road, and NW 61st Avenue) inhibit the channel from shifting north of its current and historical locations, and prevent any future avulsion into the project site along this route.–

*North Mill Creek (River Mile 9.2) to Ridgefield Mining Area Entrance (River Mile 8.3)***.** The planform analysis indicates that the channel has had a trend of northward migration in the upstream portion of this reach in the recent past. The profile analysis shows that the river slope through the former Mile 9 Pit is slightly less than the slope immediately upstream, which may be causing increased sediment deposition. Recent field investigations show that the channel continues to deposit material on a point bar on the south side of the main channel. The buildup of sediment on this point bar is causing erosion along the north bank at site C (Figure 3-10).

From recent field investigations, it is estimated that the river channel has migrated approximately 200 feet to the north at site C since 1996. Headcutting caused by the capture of the Mile 9 Pit in 1995 does not appear to have caused the channel to incise upstream or reduced the rate of deposition and lateral migration along this reach. The East Fork Lewis River is expected to continue its northward migration at this location in the near future.

Downstream of the Mile 9 Pit, the south bank of the river is confined by the Pleistocene terrace and the underlying Lower Troutdale Formation. Periodic undercutting and erosion have recently reactivated mass wasting in this area and have accelerated the rate of erosion and undercutting in the fine-grained lower unit of the Troutdale formation.

The 1854-era map (Collins 1997) shows a former channel that flows to the west and northwest at approximately River Mile 9 (Figure 3-7). The abandoned county gravel mine was excavated from within this former channel (Figure 3-6). Near the county excavation areas, the 1854 channel splits again to the west and northwest. The westerly path flows along a relict meander bend just south of Storedahl Pit Road, and modeling indicates that it is within the hydrologic floodplain and the CMZ (Figure 3-6). The northwesterly path was directed toward existing Pond 1 but is outside of the current CMZ. If the East Fork Lewis River continues to migrate north and captures the abandoned county excavation areas at site D, the new preferred flow path would most likely be from site D to site F (Figure 3-10), as the slope between these points is relatively steep. However, it is also possible that a significant proportion of the flow would be routed through the relict meander just south of Storedahl Pit Road between site D and site H (Figure 3-10). If the relict meander begins to consistently transmit a large proportion of normal flood flows, then the risk of an avulsion into the existing Daybreak Pond 1 would increase.

Another potential avulsion path is the meander bend abandoned in 1995 that contains site F. If further sediment deposition in the Mile 9 Pit occurs, it could cause the channel to shift north through this meander. However, the recent movement of the channel into the Ridgefield mining area has substantially increased the slope of the channel between sites C and I. Sediment that would otherwise be deposited in this section of channel is now carried downstream and deposited in the Ridgefield Pits. The potential for northward migration of the channel in this reach of the East Fork Lewis River has been significantly reduced by the presence of the Ridgefield mining area and is not expected to increase until the Ridgefield mining area ponds fill, which could take decades (final HCP Technical Appendix C).

*Ridgefield Mining Area Ponds Entrance (River Mile 8.3) to Ridgefield Mining Area Ponds Exit (River Mile 7.6)***.** The avulsion of the East Fork Lewis River into the Ridgefield mining area in 1996 effectively reduced the risk of avulsion into the project site at sites H and J in the near future. The abandoned channel between sites I and J remains within the CMZ. However, at site H, the Daybreak ponds are separated from the baseflow channel by approximately 425 feet of land constituting the existing operations area. Thus, the path from site H to the Daybreak ponds is considered to be outside of the CMZ under existing conditions and not at risk of avulsion along this path. Please see the Planform and Profile Analysis in final HCP Technical Appendix C.

The potential avulsion path between site J and Daybreak Pond 5 is within the CMZ. Although a breach into Pond 5 could occur at site J, if this were to occur, the East Fork Lewis River would not continue to avulse through the other ponds, since that would require upgradient flow. It is most probable that the river would form a connection with Pond 5 similar to the former connections of Ridgefield mining area Ponds 7 and 8 with the former river channel.

Potential for Mining Pond Capture

Because avulsions are triggered by unpredictable, random, events such as logjams, landslides, large floods, or upstream changes in river position, it is not possible to predict definitively when or if an avulsion will occur (Shannon and Wilson 1991). However, the risk of avulsion at one location along the river versus another can be qualitatively evaluated to estimate the potential locations of future avulsions. An evaluation of the avulsion potential in the vicinity of the project site was conducted based on available information and historic trends (see WEST Consultants, Inc., Technical Appendix C, final HCP). The results of this planform analysis do not imply that an avulsion will definitely take place in the future at the indicated locations shown on Figure 3-10, but rather, that if an avulsion were to occur, the indicated sites are the most likely locations where avulsion would occur. Please also see HCP Sections 3.3.2.2 and 6.2.6, HCP Technical Appendix C and Addendum 1.

Ability to Mobilize Existing Bank and Levee Sediments

The bank material near the project site is comprised of sediment that was previously deposited by the river as it migrated back and forth along the valley bottom. The river can erode these unconsolidated sediments. The bank material is more vulnerable to erosion along the outside of meander bends. It should be noted that the "levees" between the ponds and the river were not constructed by adding material along the riverbanks, but rather are remnants of the naturally formed land surface. Therefore, the levee sediments are comprised of the same sediments as the bank sediments and have the same erosion potential. Trees and other vegetation along the riverbanks provide some resistance to erosion, although field observations suggest that the river can undermine trees and transport them downstream. However, vegetation can influence the direction and extent of river migration. Logjams are known to be significant influences on the geomorphology of rivers in the Pacific Northwest (Abbe and Montgomery 1996; Sedell and Frogatt 1984).

3.3.2 Environmental Effects and Mitigation on the Floodplain

Following is a discussion of the environmental effects and mitigation for each of the analyzed alternatives with respect to the floodplain, including avulsion, potential pond capture and mobilization of sediments.

3.3.2.1 Effects and Mitigation of Alternative A-1 on the Floodplain: Partition the property into 20-acre parcels and sell as rural residential/agricultural tracts

Effects: Under Alternative A-1, the development of buildings and infrastructure in the geomorphic floodplain and the 100-year floodplain would increase the potential for property losses during flood events. It is possible that the magnitude of floods and the vulnerability to avulsion could increase compared with existing conditions. It is likely that additional residential construction in or near the 100-year floodplain will lead to further bank hardening (riprap) and flood protection levees. Infilling and reconfiguring of the existing ponds, increased vegetative cover, monitoring of river channel migration and a lower risk of residential flooding, would not be realized as under the preferred alternative. Under this alternative of converting the property to 20-acre tracts, no restoration planting or habitat conservation would be required although the subsequent property owners could voluntarily choose to implement similar measures. There would be no programmed systematic monitoring of the river channel and no coordinated avulsion contingency plan to minimize environmental effects associated with flooding and possible channel migration. The existing flat pastureland would likely remain similar to its current character, but with increased residential development. Increased fear of risk or claims against flood insurance by subsequent property owners could place pressure on FEMA for emergency action associated with flooding and/or the U.S. Army Corps of Engineers for increased flood control measures.

Mitigation: The Clark County code sets minimum elevations for the lowest habitable floor for new residential structures constructed in the 100-year floodplain, as well as other construction standards or flood-proofing measures, but it does not prohibit development within the 100-year floodplain, except within the portion of the 100-year floodplain designated by FEMA as the floodway. All building sites would be outside the floodway as required by Clark County. Development outside the 100-year flood boundary is not regulated by county floodplain regulations. Future landowners could construct their residences both within and outside the regulated floodplain. Construction in the floodplain would be required to comply with local government floodplain code requirements and, if landowners mortgaged the improvements through financial institutions, they would be required to purchase FEMA-sponsored flood insurance. Elevating the structures would result in the structures avoiding flood damage during a 100-year flood, and insurance would compensate for damage should it occur during a flood of greater magnitude. However, neither of these actions would directly prevent or reduce the potential for avulsion. In the event of increased flood hazard, there would most likely be engineered structural controls, such as bank hardening and/or levees, put in place to protect the improved property, housing and infrastructure.

3.3.2.2 Effects and Mitigation of Alternative A-2 on the Floodplain: Mine with no ITP

Effects: Future aggregate mining operations at the Daybreak Mine, under this alternative, would be conducted outside the 100-year floodplain of both the East Fork Lewis River and Dean Creek and would have no direct physical effect on channel morphology or riverine habitat. The new ponds would be located outside the 100-year floodplain and would be separated from the current channel and all potential avulsion paths by lands to the south and the existing Daybreak ponds. In much of the area, the existing and new ponds are further protected from avulsion by the presence of county and private roads, the processing area, homes and other development. If an avulsion threat developed during the period of mining, there would undoubtedly be a response to protect county infrastructure and the improved property at or near the site. The same responses to protect the county infrastructure and private roads should be expected after mining is terminated and reclamation is complete. Thus, expanded mining at the site would not increase the risk of future avulsion during the period of active mining or afterward. However, channel migration studies, conducted by Collins (1997) and Bradley (1996), and the 1996 avulsion through the Ridgefield mining area (WEST Consultants 2000) suggest that future avulsion and capture of the existing ponds at the project site, while improbable during the next several decades, must be considered possible over a longer time scale.

This potential for a lateral migration of the river would occur once geomorphic recovery is completed within the reach of the Ridgefield pits. Lateral migration could allow the channel to move back to a location near the existing Daybreak ponds. Under the measured and inferred conditions in the river channel and considering the surveyed volume of the Ridgefield pits, the time required to complete geomorphic recovery of the Ridgefield site is estimated by WEST Consultants (2000) to be 25 years and by Norman et al (1998) to be approximately 75 years.

Mitigation: Under Alternative A-2, restriction of the reclaimed ponds to a distance of 200 feet or more from the existing east bank of Dean Creek as described in Section 3.2.1.2 and outside of the 100-year floodplain of the East Fork Lewis River would minimize the potential of Dean Creek avulsing into the new ponds. Where necessary, additional hydraulic or structural devices would be used along the south side of Storedahl's property to deflect the force of river flows, during storm events, away from the project site (See final HCP Section 4.3.5). These devices would be used in response to avulsion threats over the life of mining activities under this alternative.

Hydraulic techniques include groins, barbs, debris jams, drop structures and porous weirs. Groins provide roughness, dissipate energy and reduce velocities near the bank. Barbs are small weirs near the toe of the bank angled upstream to turn the flow away from the bank as well as create roughness to dissipate energy and reduce velocities. Debris jams are collections of large woody debris that provides bank protection by intercepting flows. A drop structure is a solid cross channel weir that redirects flow from the bank to the center of the channel to concentrate energy dissipation and reduce bank erosion. Porous weirs are low-profile structures of loosely consolidated boulders that span the entire channel and concentrate energy dissipation to reduce bank erosion.

Structural techniques include overtopping erosion protection, designated spillways, fuse plugs, avulsion sills and rock toe or rock revetments. Overtopping protection would include asphalt or concrete road surfaces over Storedahl Pit Road to harden it and prevent erosion. A designated spillway of non-erodible materials would work in concert with the overtopping protection to control overtopping flows during extreme floods that exceed spillway elevation. A fuse plug is a spillway modification where a section of Storedahl Pit Road would be filled with easily eroded material to purposefully channel water to a specific location during high flows. An avulsion sill is large rock or other non-erodible material placed at key locations to prevent downcutting and shifting of the river. A rock toe or rock revetment would provide erosion protection. This protection would be provided for the duration of the mining activities. Following reclamation, partitioning and low-density rural residential development of the property, maintenance of flood protection measures would be the responsibility of the new landowners. Like Alternative A-1, residential development of the site would likely result in increased structural controls, such as bank hardening or levees, if avulsion or flooding threatened improved property.

The applicant will also be required to prepare a updated reclamation plan for the proposed mine expansion areas for approval by DNR. It is likely that the updated plan would also cover existing Ponds 1 through 4. Because this plan has not yet been prepared or discussed with DNR, it is difficult to determine the design features related to the floodplain and geomorphology of the East Fork Lewis River.

3.3.2.3 Effects and Mitigation of Alternative B on the Floodplain: Preferred Alternative

Effects: The effects of Alternative B on the floodplain and geomorphology of the project site would be similar to those discussed in Alternative A-2, except that there would be no post reclamation property partitioning and low-density rural residential development. In addition, a $1 million endowment would provide funds for avulsion protection or response in perpetuity, while a bond would insure funding for prevention or response to an avulsion during the course of mining operations.

Mitigation: Alternative B would include implementation of conservation/mitigation measures specifically designed to enhance, conserve and protect the East Fork Lewis River and Dean Creek riverine habitats from the environmental effects of an avulsion. These are described in final HCP Section 4.3, Channel Avulsion Conservation Measures. Following is a summary of these measures.

> A conservation and habitat enhancement endowment to a non-profit organization in the amount of $1 million. The endowment would be dedicated for site improvement, supplement the proposed conservation easement on the property and would accompany the fee simple transfer of the property. A portion of the monies could be used for enhancement of floodplain ecological functions of the East Fork Lewis River basin as discussed within the final HCP.

Restoration of the 100-year floodplain on-site by retaining existing valley bottom forested areas and planting additional native conifers and hardwood species on approximately 106 acres to create a native riverine forest. Forest restoration efforts would serve to increase bank resistance and increase overbank roughness along this segment of the East Fork Lewis River.

Re-establishment of the floodplain terrace along the eastern bank of Dean Creek via regrading, contouring and replanting efforts. The floodplain reestablishment efforts would simulate the natural terracing that is likely to have historically occurred along Dean Creek prior to its historic channelization. Terraced areas would be replanted with native plant species common to the riparian environment to increase stability and flow resistance during high flows.

Sequential reclamation of the property following mining activities would be conducted under a plan designed to reduce the risk of an avulsion and minimize potential flooding effects on the property. The existing Ponds 1 through 4 would be reconfigured and partially filled based on historic channel configurations and would include forested wetland margins. Design of each new mine pit would produce, upon completion of reclamation activities, long, narrow ponds with shallow wetlands and gradual shorelines paralleling the existing channel of the East Fork Lewis River. Approximately 33 acres of forested and emergent wetlands would be created along the margins and islands proposed for the reclamation of the new ponds (Figure 2-9). Filling to create the emergent wetland will result in some infill along the margins of the wetlands. Shallow wetlands and uplands bordering the ponds would be replanted with native emergent wetland plants and conifer-hardwood forests to enhance bank stability on a total of approximately 59 acres, and created reefs and rootwads in the ponds would further add to the roughness to reduce floodwater velocity. By reclaiming the existing and proposed ponds in such a fashion, the land buffers between the river channel and the ponds would be increased and reinforced with vegetation, reducing the risk of erosion along this stretch of the East Fork Lewis River, as well as minimizing the potential for loss of property or county roads by avulsion. There should be no increase in the likelihood of flooding up- or downstream as a result of this activity. See final HCP Technical Appendix C Addendum.

Development and implementation of a functional avulsion contingency plan will be insured during mining operations through a bond and into the future through the funding for maintenance in perpetuity. Funding for the avulsion contingency plan will be the responsibility of the operator during the period of active mining and processing. The focus would be on maintaining the viability and structural integrity of the mine access road during mining operations, which would substantially reduce the potential for an avulsion event. As noted under CM-09, CM-08 provides avulsion contingencies for the long-term (after the term of the ITP) and would be funded by the endowment. In the event that an avulsion threat develops during proposed mining operations, Storedahl would monitor bank stability conditions each year following high flow conditions along the river. Design modifications or other engineered solutions specific to the location of the potential threat would be implemented subsequent to the high flow season (provided appropriate construction permits could be obtained in a timely fashion). Engineered solutions may include bioengineered modifications, such as live staking of woody vegetation, planting of live trees along the riverbank, deploying large woody debris to dissipate flow energy, and creating a riparian buffer. Hydraulic or structural solutions as described in Section 3.3.2.2, would also be considered.

Management practices would, in the event that an avulsion occurred that stranded fish, be implemented to transfer the fish back into the main channel, if appropriate. In the event that a new channel was created during an avulsion such that its position compromised the integrity of mining operations, engineering techniques would be reviewed, in consultation with applicable resource and regulatory agencies, to determine the optimal method to prevent further erosion or to redirect flows back into the pre-avulsion channel. However, if environmental analyses determined the new channel to be beneficial to the overall riverine system, appropriate modifications to other mine design features and HCP conservation measures would be made after consultation with the Services. An example might be an avulsion into Pond 5 via potential avulsion path J (Figure 3-10). If the created avulsion channel were not backfilled, the result could be access to a backwater pond, similar to that created early at Pond 6 at the Ridgefield pits. The potential positive or negative effects of such backwater ponds will become more evident during the ongoing monitoring of the Ridgefield pits per Conservation Measure 10 of the final HCP.

Continued study of the Ridgefield pits and use of the ponds as salmonid habitat in the East Fork Lewis River would occur. Active study of the effects of the Ridgefield pits, which were breached in the 1996 avulsion of the East Fork Lewis River, will provide insight on how to best manage existing and future mining activities along the valley floor. Studies would be conducted between RM 6 and RM 13 and include fish habitat surveys, visual observations of fish use, temperature and dissolved oxygen monitoring, assessment of channel shape, pool volume, sediment infill rates, and participation and assessment of planned habitat restoration efforts.

3.3.2.4 Effects and Mitigation of Alternative C on the Floodplain: July 2000 HCP

Effects: As with Alternative B, initial effects on the floodplain and geomorphology of the site would be similar to those discussed in Alternative A-2, except for the absence of post reclamation low-density rural residential development. Unlike, Alternative B, though, mining would occur on a small parcel southwest of Bennett Road that is within the channel migration zone of the East Fork Lewis River, but outside of the 100-year floodplain. Additionally, the existing ponds would be altered to include sinuous edges and some emergent wetlands, but would not be significantly reconfigured, substantially filled or planted with wetland forest, but would instead be revegetated around the perimeters with an appropriate mix of wetland vegetation transitioning to upland shrubs.

Avulsion response plans would be funded and activated throughout the period of the ITP. However, the $1 million endowment would not be available for site management in perpetuity.

Mitigation: Alternative C would require Storedahl to implement mitigation measures to conserve and protect the East Fork Lewis River and Dean Creek riverine habitats from the environmental effects of an avulsion into the existing ponds and/or proposed mining areas throughout the life of the ITP. Although similar to mitigation measures proposed in Section 3.3.2.3, these measures are less aggressive than those evaluated for Alternative B. Variations from Alternative B's mitigation measures include:

Installation of a setback levee 75 feet from Dean Creek, between the creek and mining activities in place of reestablishing a natural floodplain.

Modified restoration of the existing ponds such that pond narrowing and shallow water development would not occur to the extent discussed for Alternative B. In particular, only 30 acres of wetlands would be created, versus 59 acres proposed under Alternative B.

Limiting potential channel migration with an emphasis on structural versus bioengineered controls would be implemented. It would not include the extensive restoration, as under Alternative B, to provide more beneficial habitat conditions in the event an avulsion in the existing ponds at some point in the future.

3.3.3 Summary of Alternative Action Effects on the Floodplain

Of the four alternatives discussed, Alternative A-1 has the greatest potential for directly affecting the 100-year floodplain with the building of homes or outbuildings; Alternative A-2 would have a similar effect albeit to a lower level because fewer structures would be constructed and they would be scattered throughout the reclaimed pond and wetland complex. In the three mining scenarios, all active mining and reclamation activities would occur outside of the 100-year floodplain except for the reclamation of the existing ponds. Some restoration and enhancement measures proposed in Alternatives B and C would occur within the 100-year floodplains of the East Fork Lewis River. Many of these efforts are proposed for enhancing the natural floodplain habitat from its current state. However, the reclamation actions proposed in Alternative B for the existing ponds are intended specifically to ameliorate the potential effects of an avulsion through the existing ponds, should it occur.

Geomorphic changes to the floodplain, resulting from an avulsion of the East Fork Lewis River, could occur and cause impacts under all four alternatives. The most probable location for avulsion under all alternatives is through the existing Pond 1. In the case of Alternatives A-1 and post-mining and partitioning under Alternative A-2, an avulsion could shift the floodplain location so that existing, as well as post-partitioning structures in the area, could become more susceptible to flooding and/or capture by bank erosion in any given year. Such an avulsion could result in increased channel migration and meandering on the site, upstream and downstream from the site. In the case of Alternatives B and C, the potential for avulsion of the river into the existing ponds is reduced. However, should an avulsion occur, Alternative B provides for controlled redirection of avulsion flow path back to the main channel, a reduced potential for headcutting, and a more stable channel downstream of the site. On the other hand, Alternative C provides for engineered/structural responses to prevent avulsion and, if necessary, repair a breach after the event. Both Alternatives B and C include a funding source to respond to avulsion. However, Alternative B includes a $1 million endowment to cover costs of mitigation in the future and a bond to cover the costs of avulsion during the course of mining operations, versus funding through the life of the ITP under Alternative C, to respond to avulsion threat(s).

3.3.4 Analysis of Cumulative Effects of the Alternative Actions on Floodplain

The Daybreak Bridge located upstream of the subject property is the primary controlling factor of any change to the floodplain or geomorphology of the river downstream of that location (final HCP Technical Appendix C). There are no known plans to significantly alter the design of the Daybreak Bridge. (Arlin Clark, Clark County Public Works Department, personal communication with Skip Urling, Ecological Land Services, Inc. April 3, 2002.). Channel migration and meandering from the Daybreak Bridge to approximately river Mile 9 is also constrained by the presence of NE 269th Street and Bennett Road and the existing development located between these county roads and the river.

Under Alternatives A-1 and A-2, the potential for near term flood damage to occur to structures built on the subject property is reduced because there are ample sites above the base flood elevation available for development within several conceptual 20-acre tract configurations. Likewise, potential near term development further up- or downstream that would be permitted by local land use regulations would be restricted from the portion of the 100-year floodplain delineated as the floodway, limited in density, and is unlikely to have any effect on flood elevations or river channel location. Historic rural residential development along the lower East Fork Lewis River has resulted in some 30,000 feet of bank hardening and/or levee construction between Lewisville and LaCenter (Wade 2000), some of it put in place as recently as 1997, after the 1996 floods, to protect improved property. The potential cumulative effects of developing rural residential/agricultural tracts under Alternatives A-1 and A-2 on the floodplain and geomorphology of the East Fork Lewis River would be nominal unless subsequent owners were able to secure the appropriate permits and authorizations to install or construct measures to protect the property and investments from channel migration, avulsion, or from flood damage within the slightly broader regulated floodplain. As the site is developed for rural residential housing, and additional infilling of upstream and downstream areas within the East Fork Lewis River valley occurs, there will be greater pressure for flood and channel migration control to ensure public safety, and to protect improved property and infrastructure. Implementation of such controls, for example, engineered structures, to restrict channel migration and/or flooding could result in a wide range of cumulative effects. There is the potential for 8,000 feet or more of bank hardening or levee construction along the south side of the site, should it be necessary to protect improved property. This would, if implemented, result in more than a 25 percent increase in flood and river migration control in the lower East Fork Lewis River. Development of areas within the 100-year floodplain, but outside the designated floodway, as rural residential tracts will create a cumulative greater need for control of channel migration and flooding, and consequently, a cumulative increase in lost opportunity for channel migration and floodplain function.

Development within the 100-year floodplain will likely cause a net loss of floodplain storage. The reduction of floodplain storage would increase the delivery of fine sediments to the downstream channel, since fine sediments that would formerly have been transported into and deposited within floodplain areas adjacent to the channel will be transported downstream.

Control and constriction of the channel to protect residential development areas within the 100-year floodplain will reduce the area available for channel migration. As a documented area of natural sediment deposition, restriction of the area for channel migration and sediment deposition will increase the overall rate of deposition within the remaining area. This increase in sediment deposition will correspondingly increase channel instability. Increased channel instability may manifest itself as increased bank erosion and rates of channel migration. This would cumulatively increase the delivery of fine sediments to downstream reaches of the river.

The increased rate of sedimentation in the vicinity of the development will also steepen the channel gradient locally. Correspondingly, the upstream channel gradient will decrease due to the downstream increased rate of deposition. This will cumulatively reduce the hydraulic capacity of the upstream channel and increase the risk and frequency of flood impacts to developed areas.

An increase in channel instability also has a direct effect on the recruitment of large woody debris. An increase in the rate of channel migration might initially increase the delivery of existing large woody debris to the river. However, an increase in the rate of channel migration will reduce the amount of time that riparian trees can grow and form functionally sized large wood. Accordingly, there will be a cumulative decrease in the delivery of functionally sized large wood to the downstream reaches.

Under Alternatives B and C, the cumulative effects to the hydraulic and regulated floodplain are effectively the same as under the existing or baseline conditions. Since the property would not be developed for rural residential uses, there will not be the pressure to control or restrict channel migration and flooding when mining and processing are completed. The primary concern under the baseline and future conditions is the potential effect of an avulsion into the existing ponds. Both Alternatives B and C include monitoring channel migration and preemptive measures to avoid an avulsion, as well as post-avulsion recovery actions. Alternative C places a greater emphasis on structural control, such as the bank hardening and levees discussed under Alternatives A-1 and A-2. Alternative B provides for “avulsion readiness” to reduce potential effects should an avulsion occur. Under both of these alternatives, there would be some transport of fine-grained sediments from the existing ponds downstream in the event of an avulsion. However, the effects of this release would be short lived and have little cumulative effect. The cumulative effect of an avulsion into the existing ponds would be similar to that experienced in the Ridgefield pits, providing a sediment sink for materials transported from upstream. Under Alternative C, there could be some local headcutting and downstream incision, with a lesser amount under Alternative B because of the reconfiguration and infilling of the existing ponds. Both alternatives can allow future channel migration and Alternative B provides for increased large wood recruitment from the created forested wetlands proposed along the margins of the existing ponds.

Additional off-site development within the Dean Creek drainage would likely increase runoff in that stream and could result in it overtopping its banks into the adjacent areas developed as rural/agricultural tracts. Because no measures would be implemented under Alternative A-1 to either contain flows within the existing channel or to allow it to meander within an area where it would not cause damage to structures, there is the potential for adverse effects to structures if Dean Creek should overtop its banks during high flows. Further, with the development of additional dwellings and outbuildings permitted in the floodplain, it would become less practical to restore functional connections between the floodplain and the river. Both Alternatives A-2 and C would allow Dean Creek room for meandering with a small berm constructed to prevent it from avulsing into the ponds resulting from mining. Mining under the preferred alternative B would result in cumulative effects similar to the other mining alternatives, but includes construction of a more "natural" geomorphic floodplain, riparian zone and in-channel structure. The cumulative effect of these activities is to increase the potential for proper stream and floodplain function along Dean Creek, if and when the lower reach is rehabilitated.

3.4 Surface Water

This section describes the features and characteristics of the three surface water bodies on or adjacent to the subject property. Included are the East Fork Lewis River, Dean Creek, and the existing ponds resulting from previous mining. Following a discussion of baseline conditions, the effects of each alternative on water quantity and quality is discussed along with proposed mitigation measures.

3.4.1 East Fork Lewis River - Affected Environment/Baseline Conditions

3.4.1.1 Water Quantity

The project site is directly north of the East Fork Lewis River between RM 7.2 and RM 9. Average monthly flows were determined by direct scaling of measurements at the Heisson gage (located approximately 12 miles upstream of the project site and averaging 738 cfs) and calculating runoff in the drainage basin between the gage and the site (WEST Consultants 2000). The mean annual flow rate of the East Fork Lewis River at the project site was estimated to be 967 cubic feet per second (cfs), and ranged from 108 cfs in August to 1,909 cfs in December (Figure 3-11). The East Fork Lewis River is a gaining stream in its lower reaches, that is, its base flow is supported by groundwater discharging to the stream during low flow periods.

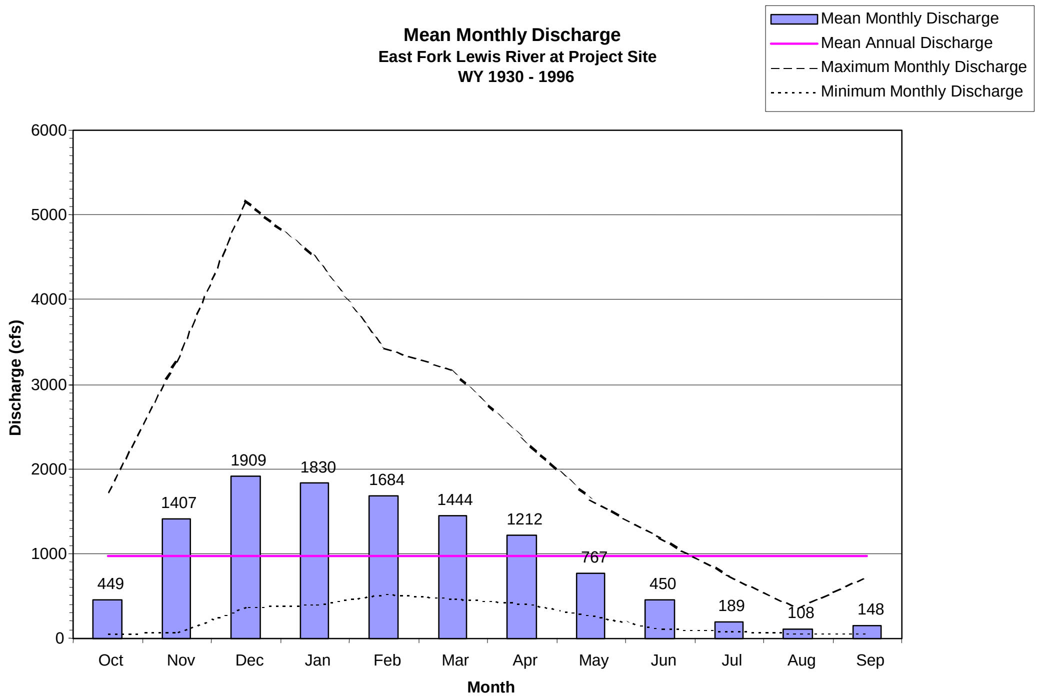


Figure 3-11: Annual and monthly flow characteristics of the East Fork Lewis River at the Daybreak site (Hutton 1995a).

3.4.1.2 Water Quality

The East Fork Lewis River in the area of the project site is designated Class A, or excellent, based on the water quality standards for surface waters of the state (Washington Administrative Code (WAC) 173-201-120 and 130). The highest rating is Class AA (extraordinary), which includes the upper reaches of the East Fork Lewis River upstream of Moulton Falls at river mile 24.6. Water quality standards for Class A surface water bodies meet or exceed the Washington State requirements for substantially all uses (for example, water supply, fish and shellfish habitat, wildlife habitat, recreation). However, water quality in Class A waters may be limited as to beneficial uses of the river during certain times of the year. Classification of surface waters is based on water quality criteria for fecal coliform, dissolved oxygen, total dissolved gas, temperature, pH, turbidity, toxic or radioactive material concentrations, and aesthetic value. The specific criteria for water quality parameters are established in conformance with present and potential beneficial uses of surface waters and do not necessarily define natural conditions. The Washington State Department of Ecology (Ecology) is responsible for water quality programs in Washington State with some oversight by the Environmental Protection Agency (EPA).

Water bodies in Washington are also categorized by how well they support designated uses. This status is determined by comparing water quality information with state water quality standards established for each classification. Water bodies are categorized as supporting, partially supporting, or overall threatened, based on the degree to which one or more beneficial uses are supported. In the 1992 *Statewide Water Quality Assessment 305(b) Report* by the Washington Department of Ecology, the overall designated beneficial uses for the lower East Fork Lewis River were determined to be partially supported for 14.5 miles below Moulton Falls with the remaining 10.1 miles unassessed (Hutton 1995b). More recent Clean Water Act (CWA) § 305(b) reports by the Department of Ecology (1995, 1996, and 1998) have not indicated whether individual streams or reaches supported designated beneficial uses. Exceeding the state standards does not preclude the East Fork Lewis River from being Class A, it means that its beneficial uses are partially supported and generally results in that water segment being placed on CWA § 303(d) lists submitted by the Department of Ecology to the Environmental Protection Agency.

In 1996, the East Fork Lewis River from the mouth of the river to Moulton Falls (river mile 24.6) was listed under CWA Section 303(d) of the Clean Water Act as an impaired water body because of exceedances of temperature, pH, and fecal coliform criteria (Ecology 1996). The 1998 CWA Section 303(d) list, however, included only exceedances for temperature and fecal coliform for the same reach. The observed impairments are believed to be the result of agricultural practices, failing or improperly located septic systems, and construction land clearing and grading (Hutton 1995b).

Once a water body is placed on the CWA Section 303(d) list, the state is required to establish a total maximum daily load (TMDL) for all listed segments. The TMDL includes an analysis of the amount of pollution a water body can incur while retaining its beneficial uses (recreation, industrial, or the support of aquatic life). The TMDL also includes controls to prevent or limit pollution and a monitoring plan to test their effectiveness. TMDLs for the East Fork Lewis River had not been established as of June 1998 (Ecology 1998a). Because of the number of TMDLs and determinations of waste load allocations required throughout Washington, it is anticipated that it will take Ecology until the year 2013 to complete the TMDL allocation process. It is not known when the TMDLs will be established for the East Fork Lewis River.

Temperature

High temperature during summer is one of the most important water quality issues on the lower East Fork Lewis River. Water temperatures in the East Fork Lewis River generally increase as one moves downstream, due to a combination of reduced streamside shading (from a lack of riparian vegetation) and higher air temperatures (Hutton 1995b).

The temperature standard for Washington Class A waters is 18°C (64.4°F), and temperatures in the East Fork Lewis River commonly exceed that level during warm periods in summer (Hutton 1995b; Ecology 1998a; R2 Resource Consultants, unpublished data.) In long-term records taken at Daybreak Park, located 1 mile upstream of the project site, water temperatures exceeded 18°C in 13 out of 16 years of monitoring, sometimes exceeding 22°C (Hutton 1995b). In its 1998 Section 303(d) list, the Washington Department of Ecology (Ecology, 2001) cited a total of six criterion exceedances at the Daybreak Park site from 1991 to 1996. Continuous monitoring of temperature in the East Fork Lewis River near the project site from early April to August 1998 by R2 Resource Consultants indicated that water temperatures exceeded 18°C almost daily from July 20 to August 11, 1998. Please also see HCP Section 3.1.5.1 for additional information regarding temperature effects of the avulsed Ridgefield pits on the East Fork Lewis River.

Effects of subsurface flow are not easily quantified, but they probably influence surface water temperatures on a local scale such as in the East Fork Lewis River (Stanford and Ward 1993). Surface water discharges from the existing ponds is absent or negligible during the summer low flow period and would continue to be under the water management plan per Alternatives B and C, except for the cold pond bottom water being pumped into Dean Creek for flow augmentation. Because the existing Daybreak ponds intercept groundwater and expose it to the warming influences of solar radiation and higher ambient air temperatures, temperatures in the East Fork Lewis River during summer months could potentially increase downstream of the site as groundwater from the ponds migrates to the river. However, because the groundwater gradient parallels the river in the summer, groundwater most likely enters the river considerably downstream of the project site, after attenuation of any groundwater temperature increases. In addition, due to the lag in time for groundwater to enter the East Fork Lewis River, that is, the late summer warming of the ponds and the discharge via groundwater to the river in the fall, the effects do not coincide with the peak temperatures in the East Fork Lewis River. Actual arrival time of subsurface flows at the East Fork Lewis River can be calculated using the aquifer constants discussed in Section 3.5 and the late summer groundwater gradient. The calculated time of travel of groundwater from the ponds to the East Fork Lewis River is from 70 to more than 200 days. Groundwater seepage leaving Pond 5 in early August would be naturally cooled as it passes through the aquifer matrix, and would reach the river in October or later, therefore temperature effects from the future or existing mining ponds are likely insignificant. This conclusion is supported by seasonal measurements in the river, wells and piezometers over the past several years, as well as continuous recorder monitoring data from November 2000 through December 2001 (Figure 3-12). See also HCP Section 3.1.4.2 regarding groundwater flow systems, seepage velocities and groundwater/surface water connections.

Because temperature is critical to the survival of anadromous salmonids, its detrimental effect on them is of particular concern. As noted earlier, the East Fork Lewis River is 303(d) listed due to high temperatures. Ecology monitoring data show that over the past 25 years, the East Fork Lewis River commonly exceeds 20° C during July and August and periodically exceeds 25° C (Geoengineers 2001). The existing temperature regime in the lower East Fork Lewis River is problematic and will most likely continue to be so in the future, with or without the expansion of the Daybreak mine.

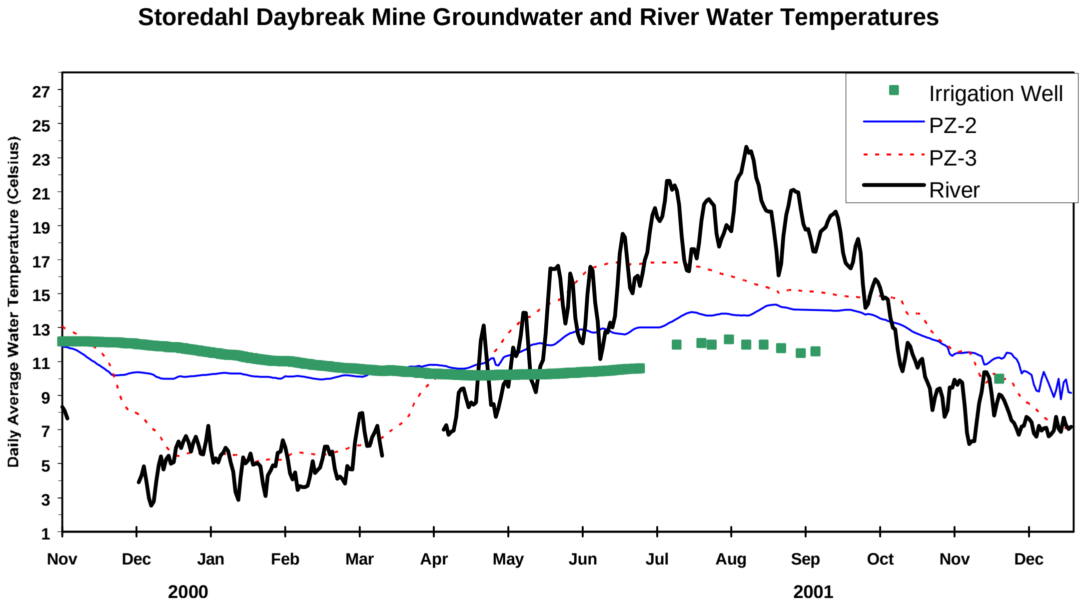


Figure 3-12: Storedahl Daybreak Mine Groundwater and River Water Temperatures

Dissolved Oxygen

Dissolved oxygen levels in the East Fork Lewis River fluctuate daily, but recorded levels have not been lower than the class A criterion (8 mg/L) in monthly monitoring between 1976 and 1992 at the Daybreak Park station (Hutton 1995b). The relatively high dissolved oxygen levels probably result from turbulent flowing water and carryover from higher dissolved oxygen levels upstream (Hutton 1995b). Low dissolved oxygen levels do not appear to be a water quality issue in the East Fork Lewis River near the project site.

Turbidity

Turbidity levels in the East Fork Lewis River exceeded state turbidity standards for the watershed (5.5 nephelometric turbidity units (NTU~~s~~))[6] several times in monthly monitoring at the Daybreak Park station before 1986, with one measurement in 1984 reaching 40 NTUs. No exceedances in turbidity were recorded in monthly monitoring by

6 A unit used in measuring water quality. Turbidity is an optical property: the scattering and absorption of light by solids suspended in water. In other words, water is turbid if you can't see through it. An instrument called a nephelometer (from a Greek word meaning "cloudy") measures turbidity directly by comparing the amount of light transmitted straight through a water sample with the amount scattered at an angle of 90° to one side; the ratio determines the turbidity in NTUs. The instrument is calibrated using samples of a standard solution such as formazin, a synthetic polymer. Drinking water should not have a turbidity above 1 NTU, although values up to 5 NTU are usually consider safe. Outside the U.S., this unit is usually called the FNU (formazin nephelometric unit).

the Department of Ecology from 1986 to 1997 (Hutton 1995b, Ecology 1998b). Monitoring in a water quality assessment of the East Fork Lewis River watershed also found no exceedances in turbidity (Hutton 1995b). The lower East Fork Lewis River is neither on the 1996 Section 303(d) list, nor the 1998 candidate Section 303(d) list for exceedance of turbidity criteria.

The General NPDES permit for the site includes a standard of 50 NTU at the discharge assumes a 10:1 dilution in the receiving water body approximating the 5.5 NTU watershed standard. As discussed in the final HCP Section 3.1.5.1, increases in turbidity and associated suspended sediments are detrimental to visibility, which impacts feeding efficiency, predation, respiration and distribution of salmonids. Recent advanced treatment of storm and process water at the Daybreak processing site have demonstrated that, with the use of flocculants and coagulants, the turbidity levels of water discharged from Pond 5 are well below the NPDES limit of 50 NTU. Over the past two years the discharge during processing operations has been below 11 NTU and generally averages 8.5 NTU, or approximately equal to the state water quality standard for the watershed. Recent, Fall 2001, turbidity measurements in Pond 5, Dean Creek, and at the confluence of Dean Creek and the East Fork Lewis River demonstrate that during storm runoff, the turbidity of the pond discharge is significantly lower than that of Dean Creek itself. Specifically, the turbidity at Pond 5 was 13.5 NTU, 26 NTU in Dean Creek and 18.2 NTU at the confluence of Dean Creek with the East Fork Lewis River on November 14, 2001. From this information, turbidity does not currently appear to be a problem in the lower East Fork Lewis River near the Daybreak Park station, although sporadic high levels have been documented, particularly prior to implementation of more advanced water measures at the Daybreak site. As noted elsewhere, process and stormwater leaving the site enters the East Fork Lewis River via Dean Creek. Furthermore, core sampling above and below the confluence of Dean Creek with the East Fork Lewis River has shown no significant differences in the concentration of fine sediments. Therefore, it is unlikely that processing or stormwater discharges have any effect on salmon spawning or hatching success in the East Fork Lewis River (see final HCP Chapter 3).

Fecal Coliform

Fecal coliform is one of the most common and pervasive water quality problems in the East Fork Lewis River basin (Hutton 1995b). In monthly monitoring by the Department of Ecology on the East Fork Lewis River at Daybreak Park, exceedances of criteria for fecal coliform were frequent but sporadic up to 1983 and have been less frequent from 1983 to 1997 (Ecology 1998a, Ecology 1998b, Hutton 1995b). Despite these exceedances beyond criteria, the Daybreak Park station was the only subbasin in the East Fork Lewis River basin to fully support the beneficial surface water uses that depended upon this parameter in 1992 (Hutton 1995b). The lower East Fork Lewis River reach represented by the Daybreak Park monitoring station is on the 1996 Section 303(d) listing for exceedance of fecal coliform criteria based on exceedances in 1988 and 1989, but is not on the candidate 1998 Section 303(d) list due to a lack of exceedances beyond criteria, between September 1994 and September 1995. The candidate 1998 list includes the East Fork Lewis River above the Moulton Falls monitoring station and below Pollack Road near the La Center monitoring station.

Given the data available, the reach of the East Fork Lewis River near the project site does not appear to have water quality problems related to fecal coliform. However, high fecal coliform levels in the past and the ongoing prevalence of water quality problems due to fecal coliform elsewhere in the basin suggest that fecal coliform may still be a potential water quality concern in the East Fork Lewis River.

Other Water Quality Parameters

The lower East Fork Lewis River was on the 1996 Section 303(d) list for two pH-based exceedances beyond the criterion (pH between 6.6 and 8.5) in 1989 and 1990 (Ecology 1996). But lack of exceedances from 1991 to 1997 resulted in its exclusion from the 1998 candidate Section 303(d) list for pH (Ecology 1998a, 1998b). The pH values of most stream waters in the United States range from 6.5 to 8.5 (Warren 1971). The overall lack of pH problems in the East Fork Lewis River basin indicates that natural geochemical processes buffer the system so that pH levels remain fairly constant. (Hutton 1995b). Buffers are solutions that resist changes in pH levels when acidic or alkaline solutions are added. Buffers are added to streams as a result of weathering or dissolution of minerals in the stream sediments. The result is that the buffering capacity of a stream naturally increases as streams flow from high to low elevation because of the increased time the water is in contact with bedrock (Welch et al. 1998).

Relatively high levels of total suspended solids (up to 94 mg/L) have been recorded sporadically at Daybreak Park in the past (Ecology 1998b; Hutton 1995b). However, since there are no state criteria for total suspended solids, the extent or severity of the problem is difficult to assess.

Nutrients such as ammonia, nitrate/nitrite, and phosphorus do not appear to be water quality problems in the lower East Fork Lewis River. Although elevated levels of these nutrients sometimes occur in tributaries, dilution appears to adequately lower their concentrations in the mainstem river (Hutton 1995b).

3.4.2 Dean Creek – Affected Environment/Baseline Conditions

3.4.2.1 Water Quantity

Dean Creek borders the northwest portion of the project site from J.A. Moore Road to the western edge of existing Pond 5, a distance of approximately ½ mile. Depending on the season and amount of beaver dam activity further downstream and offsite, Pond 5 empties directly into Dean Creek at the northwest corner of the pond. During high winter flows in Dean Creek, and during periods of intense beaver dam building activity, Dean Creek sometimes flows into Pond 5 and subsequently discharges at the west or southwest side and then is conveyed back to Dean Creek via a man-made channel on adjacent property not owned by Storedahl to lower Dean Creek.

Only two instantaneous flow measurements are available for Dean Creek. In October 1987 and October 1988 respectively, the flow in Dean Creek was 0.10 cfs and 0.15 cfs (McFarland and Morgan 1996). The monthly flow pattern is believed to be similar to that of the East Fork Lewis River. High flows occur during the winter months of November to February, while low flows are fed by groundwater during the late summer months of July through early October.

Over the past few years, Dean Creek has gone or becomes subterranean in the summer near J.A. Moore Road. The gradient of the stream changes rapidly at this location, as the stream enters the relatively flat East Fork Lewis River valley. Coarse gravel and cobbles are deposited, providing a highly porous medium for water to flow through. The stream is confined between low levees just downstream of the J.A. Moore Road Bridge, and coarse material is reportedly removed by Clark County on an annual or near-annual basis to maintain the stream channel under the bridge and thereby protect the county road crossing (EMCON 1998).

The upper reach of Dean Creek (referred to in this document as just downstream of the the J.A. Moore Road bridge) tends to go dry or subterranean in the late summer months. The lack of surface flow in this reach is related to aggradation, or the deposition of cobbles and gravel in this reach, due to the rapid break in slope of the streambed. Past mining at the site has occurred several hundred feet down gradient, and there does not appear, nor is it reasonable to expect for there to be a causal effect between mining at the Daybreak site and the lack of flow in Dean Creek during the late summer.

3.4.2.2 Water Quality

Water quality in Dean Creek affects the quality of fish habitat in the creek, water quality in Pond 5 (which it enters during high flow periods), and water quality in the East Fork Lewis River where it enters approximately 0.4 miles downstream of the Storedahl property. Land use upstream of the project site affects the water quality in Dean Creek. These land uses include low-density residential development, pasture land, and off-site mining/grading operations immediately upstream of the J.A. Moore Road Bridge. The stream flows through pastures and low-density residential development, as well as forested land for most of its length upstream of the J.A. Moore Road. However, after the creek crosses under J.A. Moore Road, forested cover becomes discontinuous to nonexistent and the creek flows through pastureland historically used by dairy cattle. The adjacent property owner has recently erected fencing on the west and north side of Dean Creek to control livestock access. Surface flow is generally intermittent to non-existent in late summer, precluding use by salmonids.

Water quality data for Dean Creek is limited to that collected by EMCON and R2 Resource Consultants in 1998. These data are from two stations, one upstream of the Storedahl property at the J.A. Moore Road Bridge and the second at Pond 5 (Pond 5 station). Data are available from six dates in March, April, June, August, September, and

December 1998, and from continuous temperature monitoring from April to August 1998.

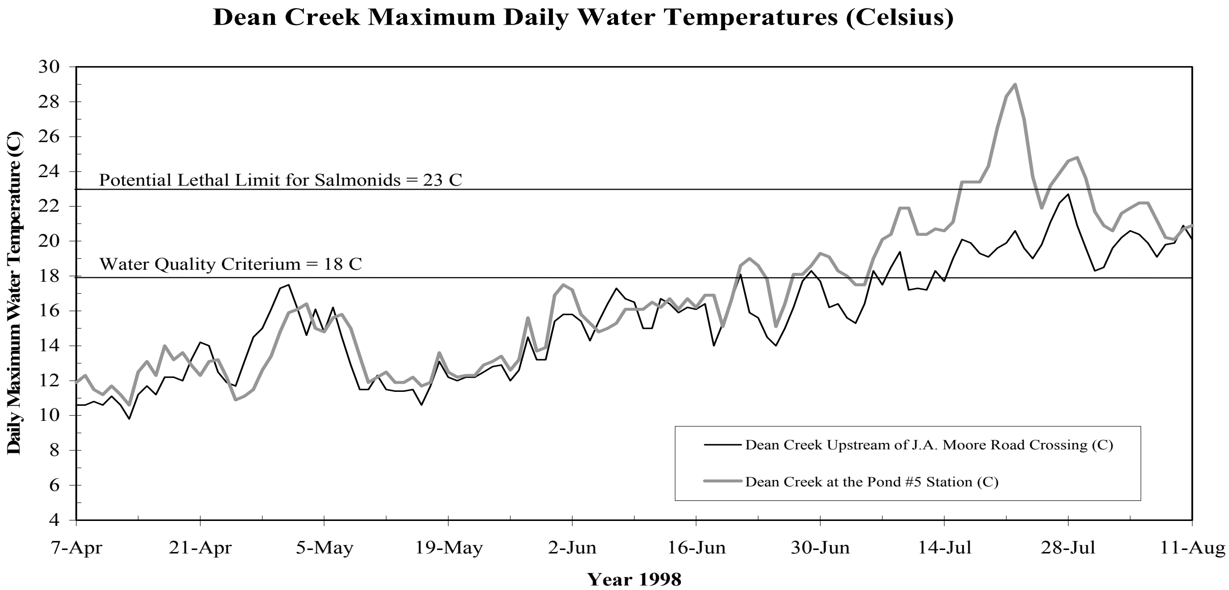
Temperature

Water temperature in Dean Creek above the project site becomes moderately high during summer months, based on continuous monitoring from April to August 1998 (Figure 3-13). Based on weather patterns in 1998, these data are reasonable estimates of representative summer conditions in Dean Creek. Water temperatures in Dean Creek during August 1998 might have been somewhat higher than average, due to a combination of higher-than-average air temperatures and lower precipitation. Water temperature in Dean Creek at the Pond 5 station was similar to temperature upstream at the bridge station through June, but it was higher in July and August. The increase in temperature downstream of the J.A. Moore Road bridge in warmer months correlates with the lower canopy cover of riparian vegetation and lower flow in the downstream station compared with the upstream station. Although temperatures in Dean Creek were not measured between the Pond 5 station and the confluence with the East Fork Lewis River, lack of a defined channel and beaver dams in this reach most likely contribute to further temperature increases. Lower velocities and greater water surface area behind beaver dams typically result in warmer water temperatures.

At both stations, water temperatures exceeded 18°C, the standard for Class A surface freshwaters (WAC 173-201-060(2)(c)(iv)) during late July and early August 1998, with the Pond 5 station consistently above that level. Exceedances of 24°C (considered lethal to most salmonids) were recorded at the Pond 5 station, but not at the bridge crossing station. Flow between the two stations is discontinuous in the late summer. August 1999, temperatures at the Pond 5 outfall have ranged from 21.6 to 22.6° C.

Dissolved Oxygen

Historic dissolved oxygen data for Dean Creek are very limited, consisting of five measurements at each of two stations monitored by EMCON in 1998. These data suggest that in summer, dissolved oxygen levels in Dean Creek downstream of the J. A. Moore Road Bridge decline to levels stressful to fish (less than 8.0 mg/l). However, the water remains well oxygenated above the bridge. This pattern is consistent with conditions in the upper reaches of the creek, where the stream is well shaded (maintaining lower temperatures) and has a higher gradient (providing turbulence and oxygenation). More recent dissolved oxygen monitoring at the Pond 5 outfall, associated with the process water treatment field-testing, recorded levels ranging from 8.0 to 9.1 mg/L.



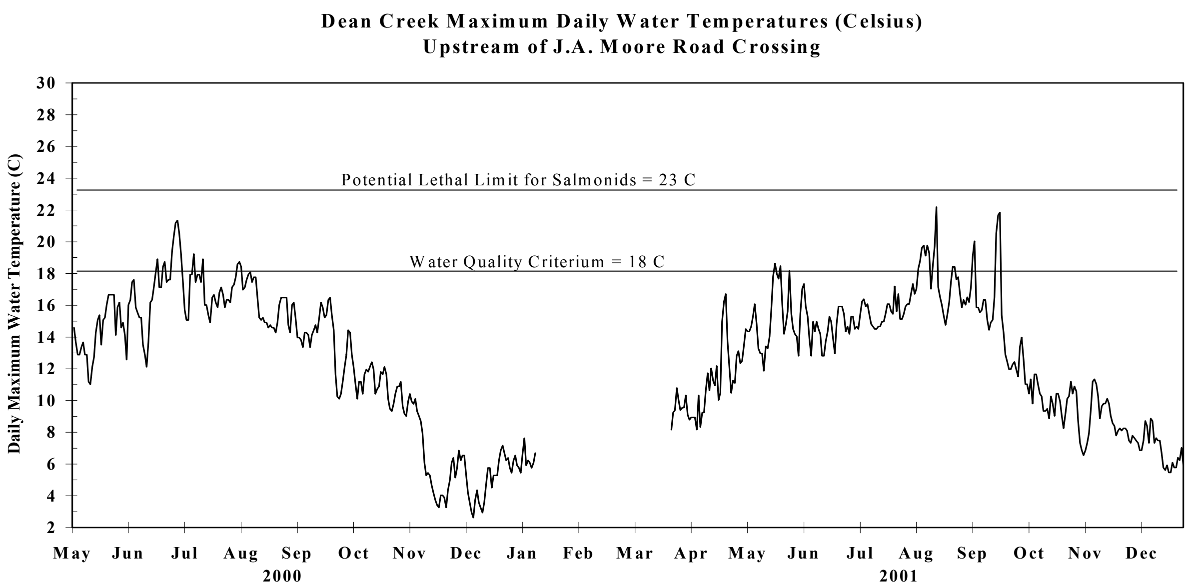


Figure 3-13: Continuous summertime water temperature in Dean Creek during 1998, 2000 and 2001

Turbidity

Turbidity data for Dean Creek are limited. However, one measurement at the Pond 5 station in March 1998, a series of measurements taken in conjunction with the process water treatment system monitoring, and more recent spot monitoring during heavy storm runoff are available. These measurements indicated a relatively low turbidity level (< 5 NTUs), except during heavy storm runoff when Dean Creek was measured at 26.3 NTU, but data are too limited to make general conclusions about the potential for turbidity problems in the creek. Other tributaries of East Fork Lewis River close to Dean Creek have elevated turbidity, and turbid outflows have been observed at the mouth of Dean Creek. Lockwood Creek (2 river miles downstream) and Rock Creek (9 river miles upstream) exceeded the state criterion for turbidity (5.5 NTUs for the East Fork Lewis River basin) in 10 and 30 percent of measurements made in 1991 and 1992, as reported in Hutton (1995b). However, Mason Creek (about 1 river mile below Dean Creek) had no exceedances beyond the state criterion.

If turbidity exceeds the state criterion in Dean Creek, it is likely to be episodic, in association with high runoff periods, such as the one cited above and similar to nearby tributaries. The forested riparian zone associated with Dean Creek upstream of J. A. Moore Road would be expected to reduce sediment input, although the upstream residential development and an active surface mine on two nearby parcels, not owned by the applicant, may be sediment sources.

Turbidity effects of pond discharge on Dean Creek vary depending on flow through the hydraulic connection between Pond 5 and the creek. During heavy storm runoff Dean Creek has been observed to discharge turbid water into a relatively less turbid Pond 5. During more normal flow periods, when flow from Pond 5 into Dean Creek occurs, there is potential for increased turbidity in Dean Creek. Storedahl's NPDES permit specifies limits for turbidity levels in the discharge, and the operation is monitored for compliance with requirements of the permit. Any turbidity increases over the past two years in Dean Creek, due to discharge from Pond 5, have been well below regulatory limits, and are approximately equal to the 5.5 NTU water quality criterion for the watershed.

Fecal Coliform

Based on March and August 1998 measurements, fecal coliform levels in Dean Creek at the Pond 5 station vary dramatically. The March measurement was relatively low, but in August, fecal coliform levels were 500-colonies/100 mL, exceeding the state criterion of 100-colonies/100 mL. This high value is not surprising, since Dean Creek flows through a pasture where dairy cattle are in close proximity, and historically had direct access, to the creek immediately upstream of the station. Fecal coliform often exceeds the state criterion (100 colonies/100 mL) in tributaries monitored in the Clark County study, and fecal coliform is considered one of the most pervasive water quality problems in the basin (Hutton 1995b).

Given the widespread occurrence of high fecal coliform levels in other tributaries of the East Fork Lewis River with similar land-use characteristics, and the location of a portion of the creek adjacent to a dairy cattle pasture, fecal coliform levels are likely to be an ongoing problem in Dean Creek as it flows adjacent to the Storedahl property.

Other Water Quality Parameters

The data above comes from other published research materials. Similar studies have not been conducted on other water quality parameters and such data isn't available.

3.4.3 Existing Mine Ponds, Process Water and Operational Standards – Affected Environment/Baseline Conditions

The southern and western portion of the project site is dominated by five existing ponds that are the result of historic gravel mining at the project site (Figure 3-1). Water enters the ponds as groundwater inflow and is supplemented by incident precipitation and seasonal run-on. Water leaves the ponds by surface-water overflow, groundwater seepage, and evaporation. The contribution of each varies seasonally. The water level in the ponds generally corresponds to the local groundwater table.

Beaver activity at the existing outlets to Pond 5 and in Dean Creek influences the water levels in the ponds and the characteristics of surface flow from the ponds. Site workers have estimated that beaver activity can cause the water level in Pond 5 to rise by more than a foot, resulting in backup and a rise in Ponds 2, 3, and 4. During much of the year, water flows slowly through the beaver-dammed and flooded lowlands, eventually joining Dean Creek before it flows into the East Fork Lewis River. This flow system has been altered by a recent excavation of a drainage channel across the adjoining downstream property. Surface water periodically discharges from any 1 of 3 locations on the west end of Pond 5. The general discharge of Pond 5 is at its northwest corner. During winter high water and when there is off-site beaver dam construction downstream, water may flow into the northwest corner of Pond 5 through a direct hydraulic connection or open channel, to the defined channel of Dean Creek. This connection existed when Storedahl acquired the property. Because of downstream beaver activity, water overflows periodically from the southwest side of Pond 5 and into the lowland areas to the west. When both the northwest and southwest discharge points are restricted by beaver activities, Pond 5 discharges through another low point on its west side. This overflow contributes to wetlands and flooded conditions in the lower reaches of Dean Creek, but the recent excavation of the aforementioned channel across that area generally routes the flow from each of these discharge points to lower Dean Creek.

A small ephemeral stream runs north of J. A. Moore Road. This stream has a small catchment area, which is being reduced as a mining operation (not a part of this proposal) in the area removes the hillside on adjacent property. During extreme high runoff periods, such as the February 1996 flood, the stream discharges through culverts onto the project site. The discharge flows into low areas and eventually exits as sheetflow to a small wetland in the cornfield north of Pond 5. The stream infiltrates in the cornfield and has not been observed flowing into any other surface water body.

3.4.3.1 Water Quality

The potential for the existing and future mine ponds to impact adjacent water bodies depends on the hydrology of the ponds. This section discusses the hydrology and water quality of existing mine ponds with respect to the potential water quality impacts of future mine ponds.

Water quality data from the ponds on the project site primarily consists of continuous monitoring conducted in 1998 and follow-up spot checks in 1999 by EMCON and R2 Resource Consultants. There has also been continuous monitoring and on-going data collection of East Fork Lewis River and groundwater. Data has also been collected and analyzed from required NPDES monitoring and the sampling associated with the process water treatment field-testing. Although the ponds are no longer being mined, Pond 1 has been used from 1990 through May 2001 for primary settling of storm water and recycled process wash water from gravel processing. In May 2001, Storedahl began dry processing while a pending Shoreline Substantial Development and Conditional Use Permit is under review by Clark County. The ponds currently provide primary settling for stormwater only. Pond 1 is connected by surface flow to downstream Ponds 2, 3, and 5 in series. Process water and stormwater discharges to surface water and to groundwater through infiltration are covered by a general NPDES permit WAG-50-1359 (see final HCP, Technical Appendix D). This permit was issued July 25, 2000, and expires August 8, 2004. The permit requires twice-monthly monitoring of the outlet for turbidity, monthly measurement of pH, weekly measurement of temperature, quarterly sampling and testing for total suspended solids, and quarterly reporting of results. The general NPDES permit limits pH to a minimum of 6.0 and a maximum of 9.0; turbidity to a monthly average and a maximum daily level of 50 NTUs; and total suspended solids (TSS) to a monthly average of 40 milligrams per liter (mg/L) and a maximum daily level of 80 mg/L. There was no thermal monitoring requirement included in the 1994 permit, thus temperature data for the outlet was not reported. The more recent permit does include a requirement for temperature monitoring, however no thermal standard is specified in the current permit.

Turbidity standards under Washington Department of Ecology rules do not apply to discharges into gravel ponds such as those at the project site, if they are consistent with pond reclamation. After the ponds are reclaimed, discharges into the ponds would need to fully comply with surface water quality-based standards. Discharge from the ponds, such as to Dean Creek, is regulated under the surface water discharge limitations outlined above.

Because of the problems with offsite activities, periodic inflow from Pond 5, and the multiple outflow points, Storedahl has, in consultation with Ecology, recently moved the surface water compliance point to the Pond 3 overflow to Pond 5. The new monitoring point is a more conservative point of compliance in that it is closer to the source(s), that is, the upgradient ponds and the operations area, and will not be compromised by Dean Creek inflow or offsite activities.

Temperature

Temperatures measured in the ponds follow patterns typical of water bodies in temperate climates. In winter and spring, depth profiles of temperatures are nearly uniform (Figure 3-14). In the summer of 1998, the deeper ponds (Ponds 3 and 5) became thermally stratified. For example, surface water temperatures in Pond 5 during mid-August were well above 20°C but were approximately 12°C near the bottom (22-foot depth). In contrast, the shallower ponds (Ponds 1, 2, and 4, which are all less than 15 feet deep), showed little stratification. This lack of stratification was in part due to the continuous mixing as a result of recycling the water in these ponds through the processing plant. Mid-August temperatures in Pond 4, for example, varied only from 19.4 to 21.2°C from the surface to the bottom (8-foot depth); (Figure 3-14). In fall and winter as water temperature decreases, water in the deeper ponds mixes and returns to a uniform temperature profile (Figure 3-14). The East Fork Lewis River is a Washington Class A water with a temperature standard of 18°C and, under the Washington water quality standards, a 0.3°C limit to increases in temperature as a result of stormwater discharge when natural conditions in the river exceed 18°C (WAC 173-201A).

From this limited data set, it appears that water temperatures in the existing ponds typically exceed 18°C in summer months throughout the shallower ponds and near the surface in the deeper ponds (that is, at depths greater than 10 to 15 feet). In 1998, temperatures in shallow ponds and surface temperatures in deeper ponds were above 18°C from the first half of June through late September. Water temperatures near the surface sometimes exceeded 25°C, a level that is considered lethal for most salmonids. While deeper ponds had colder water at depth due to stratified conditions. Pond outflow temperatures were generally similar to the temperature of water at the surface.

Dissolved Oxygen

Dissolved oxygen levels in water bodies are a function of several factors, including temperature, the degree of water column mixing, photosynthetic activity, and decomposition rates of organic material.

The dissolved oxygen concentration typically decreases as temperature increases, due to the inverse relationship between solubility of oxygen in water and water temperature. When water bodies become stratified due to temperature, dissolved oxygen levels at depth can decline dramatically, as oxygen consumed in decomposition processes is not replaced by either photosynthesis or mixing with more oxygenated water.

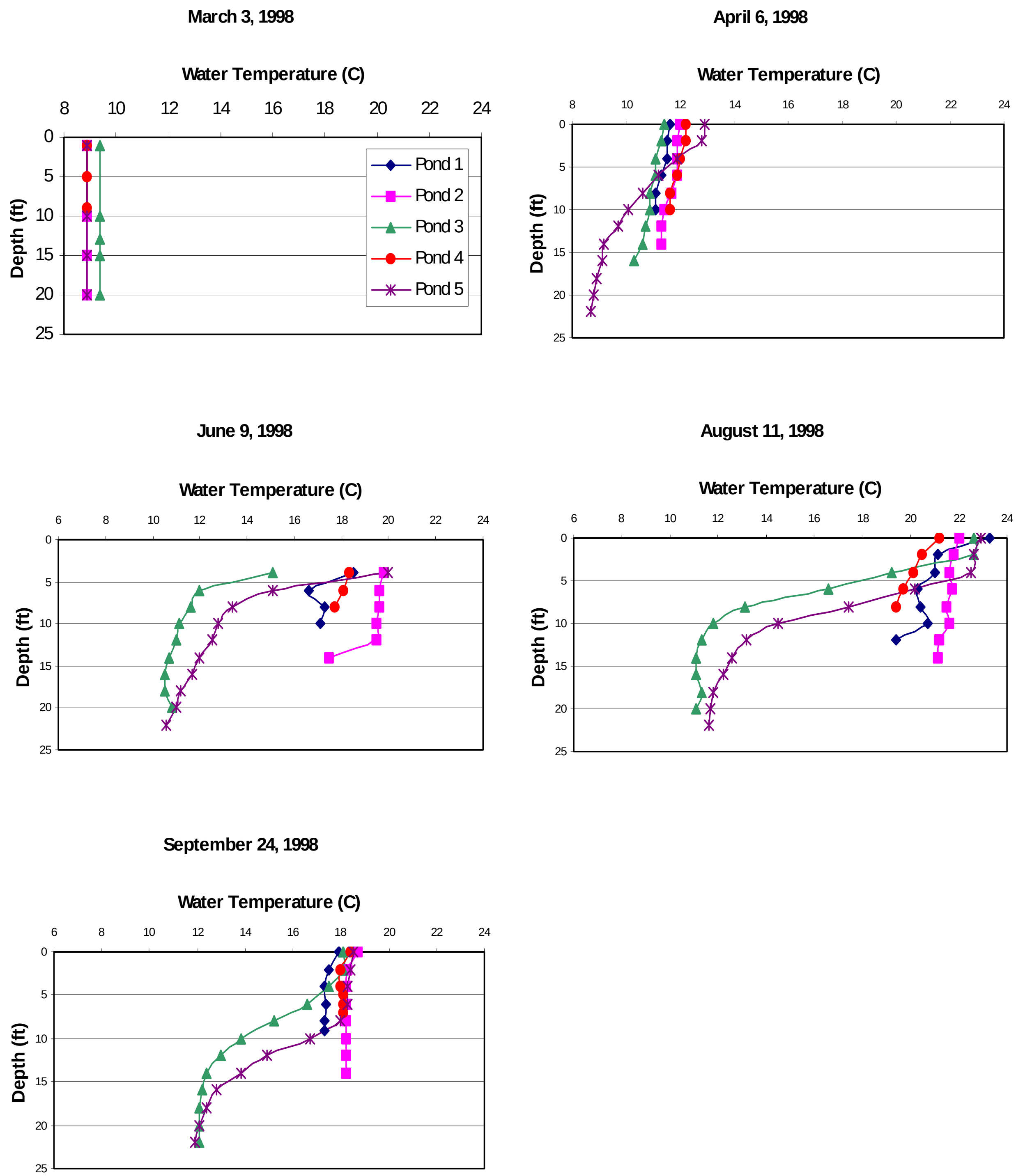


Figure 3-14: Water temperature (C) profiles in the existing Daybreak site ponds, 1998.

Because oxygen is a by-product of photosynthesis, the photosynthesis rates of aquatic plants and algae also contribute to dissolved oxygen levels. Photosynthesis rates increase with light levels and with temperature (up to a point). Dissolved oxygen levels can fluctuate substantially over 24 hours due to high photosynthetic activity during the day and respiration at night.

Mixing of surface waters with air due to wave activity and turbulence contributes to higher dissolved oxygen levels near the surface. Low dissolved oxygen levels can result in stress or mortality to fish and other aquatic animals. The Washington state criterion for dissolved oxygen in class A waters is 8 mg/L, with exceedance of the criterion being levels less than 8 mg/L.

In all five of the existing Daybreak ponds, dissolved oxygen levels were generally above 10 mg/L in March 1998. In the deeper ponds (Ponds 3 and 5), dissolved oxygen levels at lower depths had declined markedly by early June. By mid-August in the deeper ponds, dissolved oxygen levels were very low, below 8 feet of water depth (near 0 mg/L in Pond 5). In contrast, the shallower ponds (Ponds 1, 2, and 4) had dissolved oxygen levels above 8.0 mg/L across their depth profiles through the summer, except near the bottoms. The continuous mixing due to the recycling of process water in these ponds undoubtedly influences the higher dissolved oxygen levels in these ponds. Low dissolved oxygen in water near the pond bottoms was probably due to high decomposition rates in benthic sediments, that is, those sediments along the bottoms to the shorelines of the ponds.

It appears that under present conditions, a reduction in dissolved oxygen concentrations occur during the summer in the deep ponds but not in the shallower ones. Adequate mixing and possibly higher photosynthetic activity due to a higher abundance of submerged aquatic macrophytes may maintain dissolved oxygen above 8.0 mg/L in the shallower ponds. Low dissolved oxygen in groundwater entering the ponds (EMCON 1998), combined with reduced light penetration in the turbid pond water and stratification during the summer, accounts for the extremely low dissolved oxygen levels in the deeper ponds below 8 feet. Dissolved oxygen at the Pond 5 outlet station was similar to the pond surface level in the spring, but was generally lower in late summer.

Turbidity

Turbidity in water is a result of materials such as clay, silt, particles of organic matter, soluble colored organic compounds, and plankton suspended in the water column. Since turbidity reduces light penetration, it can reduce photosynthesis and productivity of a water body. Turbidity is not necessarily directly harmful to fish, although turbidity that results from suspended sediments can affect feeding efficiency (Sykora et al. 1972), predation (Gregory 1993), respiration (Sigler et al. 1984), and migration and distribution (Waters 1995). Fine-textured sediments associated with turbidity can also degrade spawning habitat and reduce reproductive success. Turbidity effects can be expected when excessive runoff occurs over land surfaces that have lost vegetation to land clearing.

Turbidity data for the existing Daybreak ponds includes two sampling periods in March and August 1998 and several years of monitoring data collected for compliance with the NPDES permit as well as the recent field-testing of treatment additives.

Turbidity in the ponds is strongly affected by whether aggregate processing is occurring on the site and the amount of silts and clays associated with the raw material. Recycled process wash water is discharged to Pond 1 for settling of fine sand and silt. Although most of the sediment settles out in Pond 1, the other ponds receive suspended sediment as water flows sequentially from Pond 1 through Ponds 2, 3, and 5 before being discharged from Pond 5. Although Pond 4 has no outlet, there is a seasonal hydraulic connection between Ponds 2 and 4. Turbidity in the ponds may also be affected by runoff from the processing area and therefore is partially a function of precipitation.

Turbidity levels on March 13, 1998, for Ponds 1, 2, 3, and 5 were 26.9, 12.7, 3.3, and 7.2 NTUs, respectively (data reported are from within the ponds and are the higher of two measurements per pond; no data are available for Pond 4). No gravel processing had occurred for two months before the measurements. Precipitation in the preceding two weeks included 10 days of rainfall, totaling 3.2 inches, with a maximum of 0.8 inches on March 1. Turbidity levels on August 11, 1998, were 775, 171, 58, 306, and 45 NTUs for Ponds 1, 2, 3, 4, and 5 respectively (data reported are from within the ponds and are the higher of two measurements for each pond). As noted, Pond 4 is generally isolated from the other ponds during low water periods. Gravel was being processed during and before the monitoring date. As with the March sampling, the data show a general decrease in turbidity as water flowed from Pond 1 through ponds 2, 3, and 5.

Quarterly NPDES permit monitoring of discharge at the Pond 5 outlet from 1997 to 1998 indicates that discharge turbidity at the outlet did not exceed the NPDES limit of 50 NTUs. Historically, the plant began processing in the early spring and continued through the fall and winter. During this period of operation, the turbidity in the ponds would gradually increase to a point where turbidity would approach the NPDES permit limit. At that point, the processing plant would be shut down and the ponds allowed to settle out for two to three months before restarting the processing operation. However, in late 1998 and early 1999 there were two exceedances at about 55 NTUs. Following the second exceedance in early February 1999 the plant was shut down. Following that shutdown, Storedahl consulted with Ecology and developed a new program, which has been implemented to reduce turbidity (Figure 3-15). This program has included the use of additives to accelerate the settling of fine-grained materials in the storm and process water, and has proved to be very effective.

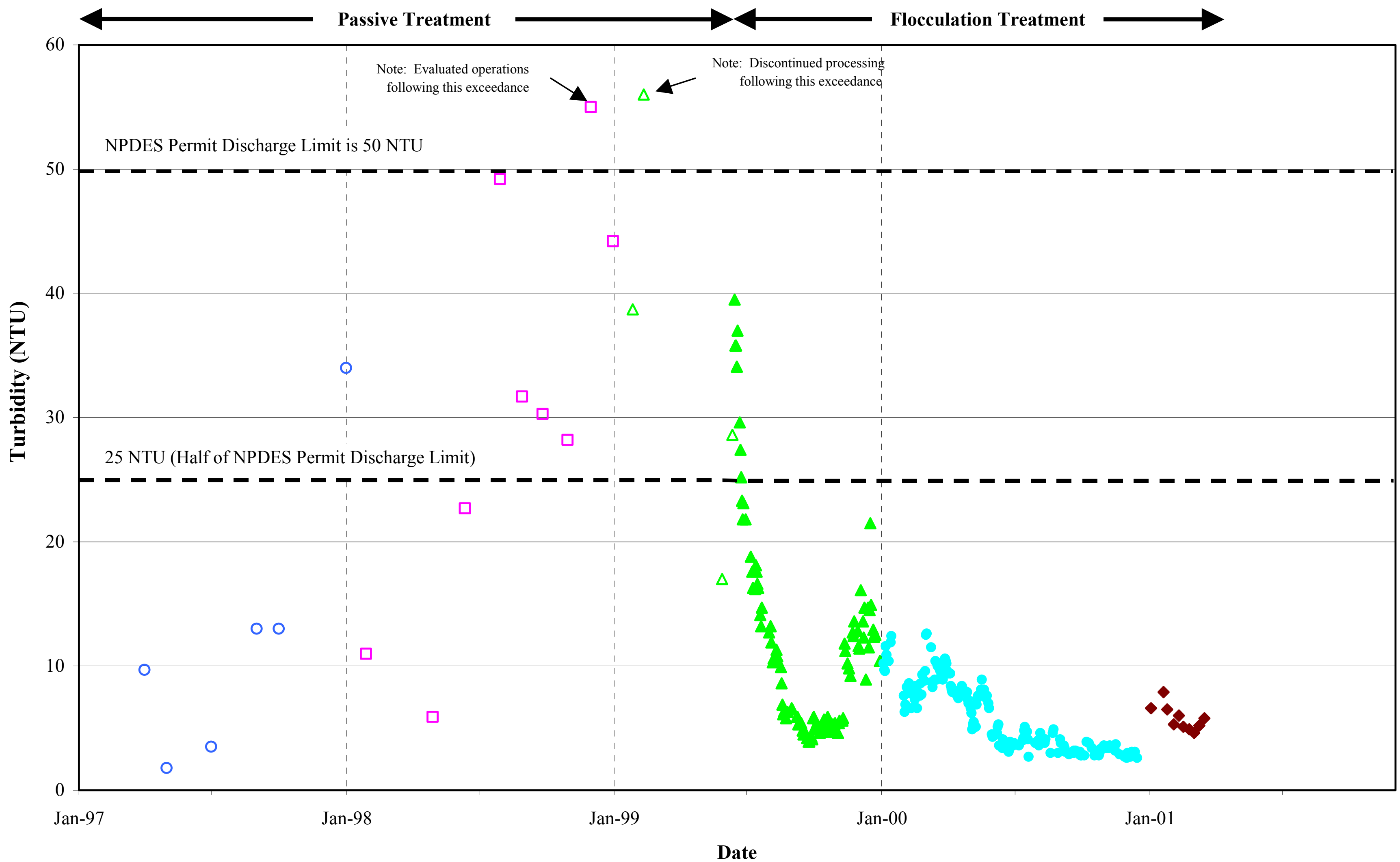


Figure 3-15: Comparison of outfall turbidity during 1997 through March 2001.

From available data, it can be concluded that under historic operations, processing of gravel and possibly stormwater runoff from the processing area increased turbidity levels in the ponds. However, turbidity levels of pond discharge were below NPDES permit limits through 1997 and 1998 with two exceptions. Sequential flow through the ponds appears to provide adequate treatment to meet the NPDES permit turbidity requirement during spring, summer and fall under historic operations. The process washwater at the Daybreak site contains suspended solids that are very fine or colloidal in size. The colloidal particles are too small to be effectively removed by gravitational settling through the ponds. The more recent incorporation of treatment additives Cat Floc 4900, Cat Floc L and Pol E-Z 7736 destabilize the colloids, causing them to combine or coagulate into larger particles. Once the particles have sufficient density, they are readily removed from the pond water by gravitational settling. Turbidity levels of the ponds, as well as the outfall, have been reduced to a fraction of the values recorded during Storedahl's monitoring for the NPDES permit (Figure 3-15).

Pursuant to the current NPDES permit, Storedahl monitors the discharge from the existing ponds. Section 3.1.4.1 of the HCP describes how Dean Creek flows into Pond 5 during high flows and/or due to beaver activity downstream and, as noted in Section 3.1.5.2 of the HCP, this inflow is periodically turbid. The flow also tends to re-suspend fine sediments in Pond 5, exacerbating turbidity in the discharge at the south and west low points in the Pond 5 berm. Conservation measure CM-04 (Water Management Plan) was designed to reduce and restrict the inflow and control the discharge during normal flow.

In consultation with Ecology, Storedahl moved the NPDES monitoring location from Pond 5 to the overflow from Pond 3 into Pond 5. This point is closer to the discharge water source and was considered a more conservative monitoring location. Ecology has notified Storedahl that it may require an individual NPDES permit for the site, following implementation of the closed-loop clarification system. Should the discharge water exceed turbidity limits, Table 5-1 in the final HCP summarizes management responses and MEM-01 (Clarification Process Monitoring) notes that the ultimate contingency measure would be to halt wet processing.

Toxicity testing of the treated recycled process water was performed using rainbow trout and two zooplankton species, *Daphnia magna* and *Ceriodaphinia dubia*. Toxicity testing results indicate that the water treated with these chemicals is not toxic to these surrogate test species. For a complete discussion and analysis of the bioassay testing see final HCP, Section 3.1.5.3. Briefly, the additives field-tested were NALCO 7888 in conjunction with NALCO 9806, Calgon Catfoc4900, Catfloc L, and Pol E-Z 7736, and Poly Alum 60 and Photafloc 1133. Toxicity tests were performed on the treated process water for each additive. Testing was performed in accordance with the applicable procedures defined in Chapter 173-205 WAC, Whole Effluent Toxicity Testing and Limits. Acute toxicity tests were performed using rainbow trout (*Oncorhynchus mykiss*) and *Daphnia magna* or *Ceriodaphnia dubia* by a laboratory certified by the Washington Department of Ecology.

Fecal Coliform

Fecal coliform levels generally indicate the presence of potential pathogens in water. Fecal coliform are bacteria that live in the intestinal tracts of warm-blooded animals and are present in bird, livestock, and human feces. The water quality standard for Washington State Class A waters states that fecal coliform levels shall not exceed a geometric mean (the mean of *n* positive numbers obtained by taking the *n*th square root of the product of the numbers, for example, the geometric mean of 6 and 24 is 12) 100 colonies/100 mL, and not have more than 10 percent of the samples used in generating the mean exceed 200 colonies/100 mL. By themselves, fecal coliform are not typically pathogenic, but their presence indicates a greater chance that human health could be compromised by disease-causing bacteria, viruses, and parasites that are also most likely present. Typical sources of fecal coliform in rural watersheds include improperly managed dairy wastes, inadequate pasture management, failing septic systems, and wildlife use of surface water.

Fecal coliform data for the Daybreak ponds are limited to one sampling period in March 1998. Maximum fecal coliform levels (most probable number) from this sampling were 11-colonies/100 mL in Pond 5. The higher of two samples in Ponds 3 had 4-colonies/100 mL, and Ponds 1 and 2 had levels below the reporting limit. All of the levels reported are well below 50-colonies/100 mL.

From these limited data, it is difficult to conclude whether high fecal coliform levels ever occur in the Daybreak ponds. Pond 5 is the most likely to have elevated fecal coliform levels, since it sometimes receives waters from Dean Creek at high flow rates after the creek passes from upstream developed areas and through a dairy farm. Fecal coliform levels were relatively high in Dean Creek during the August 1998, sampling event (discussed in detail below). The use of the ponds by high numbers of waterfowl, especially Canada geese, could also result in periodically elevated fecal coliform levels. Consequently, although high fecal coliform levels have not been detected in the ponds, levels could, under some conditions, exceed the state criterion.

3.4.3.2 Hydrology

Water enters the mine ponds primarily as groundwater seepage and precipitation. The exception is occasional Dean Creek flow into Pond 5, primarily due to downstream beaver activity. Water leaves the ponds by surface-water overflow, groundwater seepage, and evaporation. The contribution of each varies seasonally. Brief rainfall has little measurable effect on the flow. Longer, more intense storms increase surface-water discharge from the ponds. Visual observations and analysis of the local drainage patterns and surface conditions show that some surface-water runoff flows to the project site (for example, from the ephemeral stream north of J. A. Moore Road). However, all overland flow generally infiltrates into the surface soils north of the existing ponds. The site ponds are hydraulically interconnected by overflow channels and, in two cases, were historically connected by permeable rock barriers (Ponds 2 and 4, and Ponds 2 and 3).

More recently, Pond 4 has been nearly filled with fine-grained material and a culvert is present between Ponds 2 and 3.

Under the current configuration of the ponds, surface-water discharge from the ponds results in local drawdown or suppression of the water table and a net groundwater inflow to the ponds (that is, groundwater inflow is greater than groundwater outflow). Hydraulic gradient describes the change in head pressure of the groundwater with a change in distance of flow. Hydraulic head is the level which groundwater would come to in a well. It is influenced by the elevation, velocity of the water, and the amount of pressure exerted on the water. During the winter, the hydraulic gradient to the ponds is high, groundwater inflow is high, and most water drains from the pond system by surface overflow. During the summer, the hydraulic gradient to the ponds is reduced, surface discharge from the ponds is low or absent, and most water leaves the ponds as either groundwater seepage or evaporation. Groundwater seepage from the ponds is also dependent on the hydraulic gradient between the ponds and the East Fork Lewis River. The gradient from the ponds to the river is relatively constant and therefore the groundwater seepage from the ponds is relatively constant.

The water surface in the ponds generally corresponds to the local groundwater table (Figures 3-16 and 3-17). However, drainage between the ponds and from the pond system results in pond water levels that are slightly lower, on average, than the local water table. If surface discharge from the ponds were restricted or eliminated, the water level in the ponds would rise slightly and effectively equilibrate with the average groundwater elevation.

Water inflow and outflow in the pond system is controlled by the complex interaction of depth, area and interconnection of the ponds, pond outlet conditions, local groundwater gradient, and precipitation and evaporation. Surface drainage from the ponds is controlled by conditions in the pond outlets and on the downgradient property. Accumulated fine-grained sediments limit groundwater seepage through the bottom of the ponds, so that groundwater seepage occurs through the pond sidewalls.

Groundwater seepage into and out of the ponds was calculated using groundwater flow nets (Figures 3-16 and 3-17) as described in Section 3.5.1. The groundwater seepage rate from Pond 5 is affected by the water level in the ponds, which varies seasonally and depends on the height of the downgradient beaver dams.

Surface flow in the pond system consists of flow into, out of, and between the ponds. Pond 5 overflows to tributaries of Dean Creek or directly to the creek. Water periodically discharges from Pond 5 at up to three locations: the southwest corner, the western edge, and at Dean Creek (Figure 3-18). The amount of flow varies seasonally. During the summer, surface flow between and from the ponds slows significantly, except in the culvert between Ponds 1 and 2, which conveys the storm and recycled wash water flow.

Surface-water flow through the ponds and to Dean Creek and the river is influenced by beaver activity. Under existing conditions, water flows over beaver dams at the southwest corner and western discharge points of Pond 5. The connection at Dean Creek is a well-defined channel. The flow direction at the north connection to Dean Creek periodically changes due to beaver activity and drainage modifications on the adjoining property to the west. Surface water that leaves the ponds discharges directly from Pond 5 into Dean Creek at the north outlet; discharges to a wetland at the west outlet and thence to a manmade channel connected to Dean Creek; and/or discharges over the beaver dam at the south outlet into a small channel that flows west and then north into the wetland at the west outlet and thence via the same manmade channel to Dean Creek. There is a relatively large wetland area to the west of Pond 5, with a lush growth of reed canary grass and a poorly defined channel. These conditions, coupled with the beaver activity, result in some infiltration, direct evaporation and evapotranspiration of the discharged surface water. Winter inflow from Dean Creek into Pond 5 can contribute substantially to the inflow and outflow from Pond 5. Winter inflow to Pond 5 from Dean Creek is dependent on the flow and water level in Dean Creek, which are partially controlled by beaver activity and conditions on the downgradient property.

The results of the water-balance calculations (see final HCP Section 6.2.1) and interpretations of the hydrogeologic conditions (for example, groundwater contours and lithology, or the physical characteristics of the geologic layers) support the following conclusions about the pond flow system:

Some of the groundwater in the alluvial aquifer that flows toward the existing ponds from upgradient is captured by the existing ponds.

Overland flow does not contribute substantially to the existing pond volume and flow, even during moderate rainfall.

Overflow and seepage from the existing ponds results in a net hydraulic gradient from shallow groundwater into the ponds.

During the winter, groundwater seepage from the ponds is a small component of the water balance.

During the summer, surface discharge from the existing ponds decreases (to near zero in the driest part of the summer), and groundwater seepage and evaporation account for most of the water lost from the ponds.

During the winter, inflow to the existing ponds from Dean Creek periodically contributes significantly to the water balance in Pond 5. The water level in Dean Creek and inflow to Pond 5 from the creek is controlled by beavers and hydraulic conditions on the downgradient property.

3.4.4 Environmental Effects on Surface Water Quantity and Quality

As noted above, environmental effects and mitigation include both surface water quantity and quality. The primary effects and mitigation vary under each alternative, with some focusing on changes in quantity and others on quality, as noted below.

3.4.4.1 Effects and Mitigation of Alternative A-1 on Surface Water: Partition the property into 20-acre parcels and sell as rural residential/agricultural tracts

Effects: Impacts to surface water resulting from low-density rural development could include increased stormwater runoff and higher nutrient and contaminant loading. The riparian stabilization and other mitigation measures associated with reclamation and the Habitat Conservation Plan and operational improvements associated with the proposed action would not be implemented, although some wetland creation along the margins of the existing ponds would be designed to meet DNR reclamation plan standards. Adding buildings, roads, and driveways, and compacting soils in high-use areas would increase the percentage of impervious area of the site under the alternative action. The soils at the site are rapidly draining and, under typical conditions, there is effectively no surface runoff from the existing pastures or cultivated crop areas. Although the percentage increase in impervious area would be small under low-density development, the increased impervious area would result in additional stormwater runoff. As an example, an increase in impervious cover of as little as 10 to 20 percent can more than double the stormwater runoff volume compared with predevelopment levels (Schueler 1995). In addition, the runoff would carry fine sediment and likely increase turbidity during storm events, increase nutrients and contaminants associated with rural residential development, such as lawn and garden fertilizers, herbicides, pesticides, and other oils and petroleum products leaked from vehicles traveling on on-site roads and driveways. On-site septic systems, livestock manure and pet waste could contribute nutrients, (for example, nitrates and sulfates), fecal coliform (depending on livestock density), and other contaminants to runoff. Water temperature would not be expected to change and changes to dissolved oxygen would be unlikely.

Seasonal increases in pH would be expected. In pond and lake water, pH is directly related to the photosynthesis rate of algae. Through photosynthesis, plants and algae, with the aid of radiant energy such as sunlight, reduce carbon dioxide (CO_2), construct carbohydrates, and release oxygen (O_2) as a by-product. High levels of algae or plant production can elevate pH levels in a pond or lake by removing acidic forming carbon dioxide from solution during periods of intense radiant energy.

Mitigation: Measures required to comply with regulations governing rural residential development would not be as intensive as measures implemented under the proposed action. Although reclamation of existing mine Ponds 1, 2, 3, and 4 would continue, neither the habitat enhancement proposed under Alternative C nor the more extensive reclamation plantings, riparian improvements, and conservation measures under the Alternative B would be implemented.

During the development phase of Alternative A-1, mitigation measures would be implemented as required by shoreline and critical habitat regulations. Measures to protect surface water would include required building setbacks from surface water, regulations on septic-tank systems, and other county regulations applicable to rural development. Additional mitigation and conservation measures could be implemented at the discretion of the builders on each tract. Mitigation measures could include construction of grassy swales along roadways to control surface water runoff from roads, bank stabilization and plantings along Dean Creek and the East Fork Lewis River, and education and outreach to property owners.

Current mitigation and controls would go on under the continued processing phase of the alternative. The existing NPDES permit would restrict discharges from the mine ponds, and the current stormwater management plan and stormwater pollution control and countermeasures plan would be in effect. The ’closed-loop’ recirculating washwater clarifier included under Alternatives B and C would not be installed.

3.4.4.2 Effects and Mitigation of Alternative A-2 on Surface Water: Mine with no ITP

Effects: Under Alternative A-2, pond inflows and outflows are not expected to substantially affect groundwater resources or surface-water flows in Dean Creek or the East Fork Lewis River. This plan does not propose any fill in the existing ponds, but instead would result in some wetland creation along the pond margins to meet DNR reclamation standards. Note that the proposed ponds are located upgradient from the existing ponds. Minor increases in groundwater and surface-water outflows from the ponds are expected to occur during the winter because of increased incident precipitation over a larger pond area. Surface runoff from the disturbed areas would be routed to the mine ponds by grading the site during mining and subsequently after reclamation. Turbidity would increase from the sediments transported from the disturbed areas, but would decrease as the site is reclaimed and revegetated. Post reclamation partitioning and low-density rural residential development impacts would be similar to Alternative A-1, albeit with fewer developed parcels.

Mining under Alternative A-2 would add approximately 2,779 acre-feet to the approximate 535 acre-feet of existing ponds. Ponds resulting from proposed mining of the site would result in increased evaporation due to the larger surface area created by the additional ponds, see Table 6-3 final HCP.

Gravel processing at Daybreak Mine has historically generated localized turbidity in the ponds as a result of the primary settling and recirculation of process wash water. The turbidity of water released from the ponds is closely monitored and regulated through an NPDES discharge permit.. The turbidity of the discharge water complies with the limits of the NPDES permit, and the recent improvements in water treatment methods has reduced the turbidity at the outlet to levels approximating the state water quality criterion for the watershed. Mining practices under Alternative A-2 are not expected to change the amount or duration of turbid water currently leaving the site via the Pond 5 outlets. Similarly, dissolved oxygen content of water leaving the ponds is not expected to change as a result of the proposed mining activities.

Post reclamation partitioning and low-density rural residential development would result in impacts similar to those described for Alternative A-1.

Mitigation: During the period that processing of materials continues under Alternative A-2, Storedahl would continue to implement an approved Stormwater Pollution Prevention Plan and an Erosion Control Plan that meets the Washington Department of Ecology's NPDES permit guidelines for stormwater discharges in areas where over 5 acres of soil would be disturbed. These two plans would be used to ensure that best management practices are followed to reduce soil migration from other areas outside the processing area into the reclamation ponds. Water discharged from Pond 5 would also be controlled to provide seasonal temperature and flow benefits to Dean Creek.

Alternative A-2 would continue to maintain current NPDES permit levels for water quality. No new mitigation to preserve or enhance water quality leaving the Daybreak mine site would be utilized. Surface water discharges would continue to meet the discharge permit criteria, that is, a minimum pH of 6.0 and a maximum of 9.0; turbidity would be limited to a monthly average and a maximum daily level of 50 NTUs; and total suspended solids limited to a monthly average of 40 mg/L and a maximum daily level of 80 mg/L; fecal coliform would be expected to continue at present levels of below 50 colonies/100 mL, which is half of the 100 colonies/mL state standard. Temperature of the discharge would also be expected to remain consistent with present conditions.

3.4.4.3 Effects and Mitigation of Alternative B on Surface Water: Preferred Alternative

Effects: Section 6.2.5.1 of the HCP analyzed potential effects of project operations on temperature and concluded that there would be " little effect on temperatures in the East Fork Lewis River, due to time of arrival of groundwater seepage, and because of the flow contributed by the ponds and Dean Creek is low relative to mainstem flows." The mining operation and reclamation plan for Alternative B is similar to Alternative A-2 with two primary exceptions. First, mining under Alternative B would add approximately 2,493 acre-feet of surface water and 59 acres of forested and emergent wetlands. Second, process wash water would be treated in a 'closed-loop' treatment system. Use of the 'closed-loop' system should eliminate nearly all process water that would otherwise be discharged to the ponds and eliminate conveyance losses. The volume of makeup water (the volume of water withdrawn from the ponds to routinely augment the 'closed-loop' treatment system) needed to operate the system would be limited to approximately 200 gal/min. Alternative B would also result in effectively the same evaporation rates of surface water as described for Alternative A-2. Surface water leaving the site via Pond 5, though, is expected to have lower turbidity levels as a result of the incorporation of a closed loop treatment system for process water. The installation of a bottom pick-up discharge pipe coupled to discharge over a spillway and onto boulders and cobbles should result in lower temperatures and increased amounts of dissolved oxygen in the discharge. Fecal coliform levels are not expected to change. A more complete description of the proposed mitigation measures is included in the following section.

Mitigation: Alternative B would utilize a 'closed-loop' system for recycling wash waters to eliminate the discharge of process water fines to the existing treatment ponds. Use of the flocculants and the closed loop system are expected to reduce turbidity, and hence increase the transparency of the pond water. Improvements in transparency would most likely result in more photosynthesis in the ponds and a consequent increase in the amount of dissolved oxygen in the water entering Dean Creek via Pond 5. In particular, use of the 'closed-loop' clarification system would effectively eliminate process water discharges into the ponds by physically removing the solids, dewatering them for use in reclamation activities, and recirculating the treated water through the processing facility.

As with the other mining alternatives, Alternative B would require Storedahl to implement an approved Stormwater Pollution Prevention Plan and an Erosion Control Plan that meets the Washington Department of Ecology's NPDES permit guidelines for stormwater discharges in areas where over 5 acres of soil would be disturbed. These two plans would be used to ensure that water quality enhancement features are supplemented by best management practices to reduce soil migration from other areas outside the processing area into the reclamation ponds.

Differences between the stormwater and erosion control plans for Alternative B and Alternative A-2 would include the closed loop clarification system for process water. Water discharged from Pond 5 would also be controlled to provide seasonal temperature and flow benefits to Dean Creek. This outlet would incorporate a bottom pick-up to convey cooler pond bottom water into Dean Creek. The water would be discharged over a spillway, providing an opportunity for increased oxygenation. In particular, during fall, winter and spring months the pond waters would be directed through one outlet into Dean Creek. An overflow, or emergency spillway would be constructed to facilitate high or flood flows from Pond 5 to flow into the creek. In summer, when Dean Creek historically runs warm with minimal flows, deeper, cooler water from Ponds 3 and 5 would be pumped upstream into Dean Creek to reduce water temperature and increase water levels to accelerate riparian development.

3.4.4.4 Effects and Mitigation of Proposed for Alternative C on Surface Water: July 2000 HCP

Effects: Impacts associated with Alternative C would be similar to those discussed for Alternatives A-2 with the exception of post-reclamation partitioning and rural residential development and the associated effects described in Section 3.4.4.2.

Mitigation: Mitigation measures for Alternative C would be similar to those identified for Alternative B in Section 3.4.4.3 of this report.

3.4.5 Summary of Alternative Effects to Surface Water

Of the four alternatives discussed, only Alternative A-2 would have no net effect on surface waters, as processing of materials and discharge of water into Dean Creek under Alternative A-2 would continue under existing processing procedures at the site. Alternative A-1 would potentially result in increased stormwater runoff from impervious surfaces and reduced water quality from individual landowner's using pesticides and herbicides or fertilizers to maintain their residential lawns and/or from small farm activities. Alternatives B and C would mitigate potential impacts to surface water quality by utilizing enhancement features that would increase water clarity, the amount of dissolved oxygen in the water entering Dean Creek, and reduce the water temperature.

In all three mining alternatives, the amount of surface water available on-site would be increased by the creation of mining ponds where agricultural uplands exist. Approximately 64 acres of ponds exist from past mining activities; Alternatives A-2 and C would result in the creation of approximately 89 and 73 acres of open water, respectively. Alternative B would reduce the existing pond surface areas to 38 acres with the creation of forested and emergent wetlands as part of the avulsion mitigation measures, and create approximately 64 acres of new pond surface water area.

3.4.6 Analysis of Cumulative Effects of the Alternative Actions on Surface Water

The cumulative effects on surface water resulting from the four alternatives would center on water quality. In all cases, the effects on surface water quantity would be limited to an increase in surface water volumes on-site created by the ponds resulting from mining, and would not influence or be significantly influenced by other activity in vicinity.

Alternative A-1 would, when considered in past, present and reasonably foreseeable future actions, result in potentially greater degradation of surface water quality in the vicinity of the project site than the other alternatives. Alternative A-2 would also increase the percentage of impervious surface in the current cultivated fields, but at a significantly lower level. Development under this alternative would be limited to about one-half the number of dwelling sites and they would not include large areas of pastures or fields, which could be compacted or paved. Conversion of the property into large tracts for rural residential or small agricultural uses would increase the amount of impervious surface and the amount of runoff. As mentioned above, runoff would carry fine sediment and likely increase turbidity during storm events, increase nutrients and contaminants associated with rural residential development, such as lawn and garden fertilizers, herbicides, pesticides, and other oils and petroleum products leaked from vehicles traveling on on-site roads and driveways. On-site septic systems, livestock manure and pet waste could contribute nutrients, (for example, nitrates and sulfates), fecal coliform (depending on livestock density), and other contaminants to runoff. Water temperature would not be expected to change and changes to dissolved oxygen would be unlikely.

Water bodies receiving runoff under Alternative A-2 would be somewhat less affected than under the first alternative. There would be fewer tracts created after reclamation than under

Alternative A-1 resulting in less impervious surface and fewer septic tanks. Because much of the property would be converted to ponds and wetlands, there would also be less opportunity for pasturing livestock. As a result, runoff volumes leaving the site would be lower and would carry fewer contaminants.

During the course of mining under Alternative A-2, surface and process water would be treated through the existing ponds using the currently implemented treatment additive system to maintain discharge turbidity well below permitted levels. The treated water from the ponds would also continue at the current levels for pH and dissolved oxygen. Data show further that groundwater contributions from the ponds to the East Fork Lewis River would continue to be better than state standards require for temperature during critical low flow periods and would remain so.

Local and regional surface water systems would be unaffected under Alternatives B and C. Implementation of the 'closed-loop' system for process water treatment in both scenarios would further reduce turbidity levels in the discharges to Dean Creek and the East Fork Lewis River. Reduced turbidity and increased clarity, as well as the bottom pickup and spillway at Pond 5, are expected to increase dissolved oxygen. Because there would be no development after reclamation, there would be no accompanying impervious surfaces, no septic systems, and no livestock pasturing to contaminate runoff. Fecal coliform and pH levels are projected to be the same as under existing or baseline conditions. As with Alternative A-2, data show further that groundwater contributions to the East Fork Lewis River would continue to be better than state standards require for temperature during critical low flow periods and would remain so.

3.5 Groundwater

This section presents a discussion of the groundwater systems in the vicinity of the project site. The existing baseline conditions are described based on a review of existing scientific literature with verification from the collection of field data. Following this discussion of the affected environment is an analysis of the potential effects on groundwater quantity and quality for each of the alternatives. Finally, mitigation measures are presented.

3.5.1 Groundwater-Affected Environment/Baseline Conditions

The potentially effected environment includes the groundwater in the immediate vicinity and downgradient of the existing ponds. Potential impacts include changes in water availability and quality. The most important issues relate to the hyporheic zone, that is, that portion of the saturated zone where there is bi-directional mixing of surface and groundwater supporting biological activity, and baseflow recharge to the East Fork Lewis River.

3.5.1.1 Hydrogeology, Groundwater Flow Systems and Groundwater Quantity

The project site is located on the north edge of the Portland Basin (Mundorff 1964). Although several regional hydrogeologic units are defined in the Portland Basin, two of these units, the Unconsolidated Sedimentary Rock Aquifer and the Troutdale formation, are relevant to the area near the project site. At the project site, the lower member of the Troutdale formation underlies and is in hydraulic connection with the alluvial sediments that form the Unconsolidated Sedimentary Rock Aquifer. Alluvial sediments within the proposed site boundary range from about 30- to 50-feet thick, as measured from the ground surface. The alluvium consists primarily of highly permeable gravel and cobbles with a sand matrix. The underlying lower member of the Troutdale formation consists of fine sand, silt, and clay. The finer-grained nature of the lower member of the Troutdale formation makes it much less permeable than the overlying alluvial sediment, and it is not considered to be a good aquifer (Mundorff 1964).

Recharge, movement, and discharge of groundwater is controlled primarily by the topography of the basin, which creates regional, intermediate, and local groundwater flow systems. A flow system is defined by the primary recharge and discharge areas of groundwater and by the hydrogeologic conditions under which flow occurs. The Columbia River is the regional discharge area for groundwater in Clark County. Much of the groundwater discharging to the Columbia River from Clark County enters the flow system in upland recharge areas along the western Cascade Range, moves downward and horizontally toward the river, and finally moves upward to discharge to the river. The Lewis River, East Fork Lewis River, and Salmon Creek are examples of discharge (as opposed to recharge) areas for intermediate groundwater flow systems. Groundwater enters the intermediate flow system through upland recharge areas in the drainage basin of the East Fork Lewis River. Local groundwater flow systems are much smaller, and distances from recharge to discharge are on the order of hundreds or thousands of feet between recharge and discharge areas (McFarland and Morgan 1994), such as the geomorphic floodplain of the East Fork Lewis River.

The East Fork Lewis River is the ultimate discharge point for groundwater in both the intermediate and local flow systems governing the hydrogeology of the project site. Groundwater in the intermediate flow system recharges primarily by infiltration of precipitation where the Troutdale formation is exposed in adjacent uplands, and along valley slopes, and by infiltration of groundwater from overlying valley slope terrace deposits. Groundwater in the shallow local flow system recharges from direct infiltration of precipitation on the highly permeable surficial alluvial deposits, as well as from run-on and infiltration of surface water from smaller ephemeral, intermittent and perennial streams that flow onto the floodplain of the river. Some local, seasonal recharge to the shallow alluvium from the East Fork Lewis River undoubtedly occurs, especially during extreme high-water events. A secondary minor source of recharge is upward leakage from the underlying lower member of the Troutdale formation (intermediate flow system).

Groundwater in the alluvial sediments (local flow system) occurs under water table (unconfined) conditions. The typical depth to water, or static water level, on-site ranges from 1 to 13 feet below the ground surface. Greater depths to water, or static water level, are associated with local drawdown from pumping wells. The water table fluctuates seasonally, with the highest elevations in the spring and the lowest elevations in late summer and early fall.

The water table surface in the alluvial sediments generally reflects the surface topography. Natural groundwater flow in the alluvium is toward local discharge points, primarily the East Fork Lewis River and its tributaries. Shallow groundwater discharges secondarily to evapotranspiration and wells. Figures 3-16 and 3-17 show late summer and winter water table surface contours and flow lines for the alluvial aquifer. The groundwater contours indicate that flow is predominantly subparallel (nearly, but not exactly, parallel) to, and toward the East Fork Lewis River beside and downstream of the site, respectively. Groundwater flow in the alluvium near the site occurs under a hydraulic gradient ranging from approximately 0.003 to 0.008 foot/foot. Considering the measured gradient, estimated hydraulic conductivity of 300 feet/day, and an effective porosity of 0.2, the calculated groundwater seepage velocity ranges from 4.5 to 12 feet/day in the shallow alluvial aquifer. Local variations in seepage velocities are expected. For example, if a higher or lower hydraulic conductivity exists locally, the groundwater seepage velocity would increase or decrease proportionately.

Groundwater in the underlying Troutdale formation (intermediate flow system) occurs under semiconfined conditions (Mundorff 1964; McFarland and Morgan 1996). Flow in this aquifer is primarily toward the East Fork Lewis River, with secondary upward leakage into the overlying alluvial sediments. Although minor, the upward flux of groundwater from the lower member of the Troutdale formation into the alluvium, with ultimate discharge to the East Fork Lewis River, is typical of groundwater flow patterns in similar hydrogeologic settings (McFarland and Morgan 1996).

Groundwater Use

Groundwater has been and is now pumped for domestic and irrigation uses in the area of the site. The highly permeable nature of the unconsolidated alluvium results in high specific capacities (discharge per unit drawdown) and allows shallow wells to produce copious amounts of groundwater.

Groundwater/Surface Water Connections

Like most larger streams west of the Cascades, the lower reaches of the East Fork Lewis River and its tributaries are gaining streams (Mundorff 1964; McFarland and Morgan 1996). Gaining streams are streams that are recharged by groundwater inflow, gaining more volume from groundwater than they lose to groundwater on an annual basis.

The U.S. Geological Survey (USGS) evaluation of groundwater flow in the Portland Basin included a detailed study of groundwater inflow to the East Fork Lewis River (McFarland and Morgan 1996). The USGS report shows that average groundwater inflow rates at river mile 10.6 and at river mile 6.5 were 0.58 and 1.59 cubic feet per second (cfs) per stream mile, respectively. The USGS calculations were based on field data collected on the river during two low-flow periods, one each in October 1987 and 1988.

In the reaches upstream of J. A. Moore Road, Dean Creek is a losing stream during the winter when high precipitation results in runoff into the creek. During winter, Dean Creek recharges the local shallow groundwater. Dean Creek's contribution to the recharge of the local water table is significantly reduced during late summer, when its flow is greatly reduced and at the northern edge of the site its flow is subterranean.

Site water table maps (Figures 3-16 and 3-17) show that the existing ponds on the project site act as a local groundwater sink, and that groundwater locally flows into the upgradient side of mined ponds throughout the year. Under the current configuration of the ponds, surface-water discharge from the ponds results in local suppression or drawdown of the water surface and a net groundwater inflow to the ponds (that is, groundwater inflow to the ponds is greater than groundwater outflow from the ponds). During the winter, the hydraulic gradient to the ponds is high, groundwater inflow is high, and most water drains from the pond system by surface flow. During the summer, the hydraulic gradient to the ponds is reduced, surface discharge from the ponds is low, and most water leaves the ponds as either groundwater seepage or evaporation.

Groundwater inflow to the ponds was estimated using a groundwater flow net, (constructing flow lines perpendicular to the water table contours), reported aquifer properties, local stratigraphy, and the configuration of the ponds. Assuming a hydraulic conductivity of 300 feet/day, groundwater inflow to the ponds was calculated to be approximately 3.2 cfs in winter and 1.2 cfs in the summer.

The total groundwater flow from the ponds was estimated in a manner similar to that used to calculate the groundwater seepage into the ponds. The groundwater contours suggest that most of the seepage from the ponds to groundwater is from the most downgradient pond, that is, Pond 5. The calculated seepage rate from the ponds to groundwater and then to the East Fork Lewis River is 0.9 cfs. The groundwater seepage rate from Pond 5 is affected by the water level in the ponds, which varies seasonally and depends on the height of local and off-site beaver dams. However, the seasonal variation of the hydraulic gradient is small, and groundwater seepage from Pond 5 is, therefore, assumed to be constant throughout the year. The confined or semiconfined condition and fine-grained nature of the underlying lower member of the Troutdale formation, as well as the accumulated fine-grained sediments in the bottom of the ponds, limit groundwater seepage through the bottom of the ponds. Thus, most groundwater seepage occurs through the pond sidewalls. Discharge from the ponds is taken up by evapotranspiration or ultimately reaches the East Fork Lewis River. Please also see HCP Section 6.2.1.

Hyporheic Zone

Over the past two decades, stream and riparian ecologists have recognized the importance of the hyporheic zone to the stream ecosystem (for example, Stanford and Ward 1988, 1993). The hyporheic zone has been defined variously by different investigators, based on biological, biogeochemical, and hydrologic criteria. WAC 222-16-010 General Definitions states that the hyporheic zone is "…an area adjacent to and below channels where interstitial water is exchanged with channel water and movement is mainly in the downstream direction." White (1993) conceptually defines the hyporheic zone "…as the saturated interstitial areas beneath the stream bed and into the stream banks that contain some proportion of channel water or that have been altered by channel water infiltration (advection)." More rigorous definitions of the hyporheic zone generally reference Triska et.al. (1989) and the inclusion of advected channel water found within the streamside aquifer. Wondzell and Swanson. (1996) further refine Triska et.al. (1989) in defining the hyporheic zone as "… the zone beneath, and to the side of the stream, where subsurface water is a mixture of at least 10 percent advected channel water and groundwater is the hyporheic zone." Wroblicky et.al. (1998) also support this definition in that they describe as "…bi-directional exchange between surface and subsurface (groundwater) systems in near-stream groundwater regions containing water that originated from the stream." The hyporheic zone generally refers to the subsurface mixing zone or interface of groundwater and surface water and the associated biological and chemical processes (Stanford and Ward 1993; Triska 1989). The hyporheic zone potentially influences stream ecosystem processes in a variety of ways, such as providing:

- a source or sink of biological productivity;
- a refuge for benthic invertebrates during high flows; and
- a location for biogeochemical processes such as nitrogen transformations and retention, which affect stream productivity and growth of riparian plants.

The hyporheic zone occurs at different spatial scales ranging from the channel and its adjacent sediments to the floodplain of large gravel-bed rivers (Woessner 2000). Not surprisingly, investigations into hyporheic processes have also occurred over the same range of spatial scale, with some studies focusing on mixing of channel water and near-channel water (D'Angelo et al. 1993; Wroblicky et al. 1998) and others taking a more extensive approach across the floodplain (Stanford and Ward 1988; Wondzell and Swanson 1996). White (1983) suggests that the scale of the hyporheic zone would be expected to increase with stream order: a scale of centimeters for headwater streams, meters for mid-reach pool-riffle sequences, and hundreds of meters for larger rivers with well-developed floodplains.

The East Fork Lewis River runs approximately parallel to the Daybreak site and is a gaining stream located within a valley of fluvial deposits approximately 0.75 miles wide. Water table maps and associated flow nets show the paths for winter and late summer groundwater flow down the East Fork Lewis River valley is generally subparallel to the river near the Daybreak site, with a portion of the flow directed toward the river at the lower end and downstream of the site (Figures 3-16 and 3-17). In addition, groundwater flow that originates from the adjacent uplands above the valley generally moves perpendicular to the geomorphic floodplain until it merges with the shallow alluvial aquifer.

The extent of hyporheic flow in the groundwater moving parallel in the East Fork Lewis River in the vicinity of the Daybreak site can be generally delineated based on the channel and floodplain configuration, and on observations of groundwater elevations. The hydrogeomorphic setting of the river and its valley upstream of the Daybreak site suggest that hyporheic flow occurs within the active hydrologic floodplain, and could be on the scale of the geomorphic floodplain (hundreds of meters) (as discussed in final HCP Section 3.3.2.). Downstream of the bridge at Daybreak Park (river mile 10), the river crosses from the north to the south side of the valley and the valley widens. This setting provides the potential for a flow-through reach (Woessner 2000), where exchange of groundwater and surface water is likely to occur. In addition, the highly permeable sediments downstream of this location and the likely occurrence of relict channel beds (Figure 3-7) would provide favorable conditions for continuous hyporheic flow to the Daybreak site. As the groundwater contours in Figures 3-16 and 3-17 indicate, this hyporheic flow would intersect the existing Daybreak Pond 1 under both existing and built conditions, and may intersect some of the proposed Phase 1 and 2 forested and emergent wetlands in the southeastern part of the site (see Figures 2-2 and 2-3). In the area of the proposed ponds, groundwater flow is primarily recharged from infiltrating precipitation, run-on, and from groundwater discharge from upland sources (that is, is non-hyporheic) and moves toward the East Fork Lewis River. Recent continuous monitoring of water elevations and water temperatures in the East Fork Lewis River, an irrigation well northeast of Pond 1, and two piezometers near Pond 5 support this conclusion. This hypothesized hyporheic flow pattern is supported by recent results of groundwater elevation monitoring at the daybreak site (Figures 3-16 and 3-17).

Fluctuations in elevations (stage) and water temperatures in the East Fork Lewis River and the groundwater at three wells were monitored in July 2000 and during November 2000 through December 2001. Two wells are located within the presumed path of hyporheic flow (piezometers PZ-2 and PZ-3) (Figure 3-16). Piezometer PZ-2 is located about 550 feet southwest of the southwest corner of Pond 2, adjacent to a secondary channel and within the hydrologic floodplain. The hydrologic floodplain is the region of frequent flooding, or the land that is inundated about two years out of three (USDA 1998). Piezometer PZ-3 is located about 100 feet away from the river in the 100-year floodplain, about 200 feet west of the southwest edge of Pond 5. The third well (irrigation well) is located outside of the 100-year floodplain and near the break between the Phase 4 and 6 areas to be excavated for aggregate, approximately 500 feet north of the northeast corner of Pond 1. The river stage was monitored within the Ridgefield Pit reach west of the southwest corner of Pond 5.

The results of the groundwater elevation monitoring indicate that the hyporheic flow path intersects the existing Pond 1, as the water flows parallel to the river (Figures 3-16 and 3-17). Fluctuations in groundwater elevations in piezometers PZ-2 and PZ-3, which are located adjacent to and about 100 feet away from the river, respectively, closely followed the diurnal patterns observed in the river, indicating an intimate relationship between the river and groundwater in these locations (Figure 3-19). This indicates that the groundwater at these two locations is hyporheic. In contrast, the dampened variations in groundwater elevations observed in the irrigation well indicate that this location is outside of the immediate influence of the river and is likely not hyporheic water. Fluctuations in water temperatures collected from these same locations further support this delineation of hyporheic water. These data are presented in the following Section 3.1.5.2 on water quality.

Secondary channels, such as the one to the southwest of existing Pond 5, are often areas of upwelling where hyporheic water enters the channel system from floodplain sediments (Wondzell and Swanson 1996). The head differential between Pond 5 and piezometer PZ-3 near this secondary channel shows that there is a potential gradient from Pond 5 toward the secondary channel (Figures 3-16 and 3-17). In addition, the general groundwater gradient (Figures 3-16 and 3-17) and secondary channel beds (Figure 3-7) may provide suitable conditions for more permeable preferred flow paths continuing to the west of Pond 5. Thus, it appears that the flow path of groundwater from Pond 5 to the river describes the flow path of hyporheic water.

Although the existing ponds are likely located within the path of the hyporheic flow, the effect on the hyporheic flow path is believed to be localized (Figures 3-16 and 3-17). The specific effect of the existing Daybreak ponds on the characteristics of the hyporheic flow are not quantifiable, but they are expected to be similar in principle to those of a flow-through reach, where hyporheic water enters a river channel on the upstream side and goes subsurface on the downstream side. Due to differences in water quality and surface area between ponds and rivers, however, the existing ponds might have different effects than a river on the biological and chemical properties of hyporheic water as it is exchanged with surface water. Deposition of fine sediments on the bottom of the ponds might retard exchange of hyporheic and surface water, although discharge measurements in the river upstream, adjacent to, and downstream of the Daybreak site indicate that there is no loss or gain of groundwater in this area as a result of the existing ponds and the Ridgefield pits. One obvious effect is that the existing ponds have effectively replaced hyporheic volume that was present before the ponds were excavated. As a result, biogeochemical processes, such as nitrification (breakdown of nitrogen-containing organic compounds by microorganism *into* nitrates and nitrites) and denitrification (the reduction by microorganisms of nitrates and nitrites *to* nitrogen) rates, which are mediated largely by microbial organisms might be altered compared to the pre-pond conditions.

Decomposition by microbial organisms in the hyporheic waters results in the conversion of organic matter, such as leaf litter from the riparian forest, into useable nutrients that are released to the stream channel. These nutrients support algal growth, which provides a food source for grazing stream insects, which, in turn, become food sources for fish. Because mineralization in hyporheic waters is rapid relative to flow velocities, microbial activity in the hyporheos can create an enriched source of nitrate and other nutrients that are released to the stream channel (Edwards 1998). For this nutrient cycle to function, hyporheic organisms need water, food, and dissolved oxygen (Bayley 2001). This requires sufficient hydraulic conductivity, water velocity, and close access to the surface, so that fresh organic matter, which is produced at the surface through photosynthesis, can be transported to the animals as food. In alluvial Pacific Northwest rivers, sufficiently high velocities for transport would be expected to exist in frequently flooded areas under or laterally close to coarse substrate (such as within the hydrologic floodplain). In areas more distant from the active river channel, such as outside the 100-year floodplain, it is increasingly unlikely that bi-directional flow or hyporheic flow velocities are high enough to support significant quantities of hyporheic microbial colonies or invertebrates. Although the invertebrates found in hyporheic areas distant from the active channel zone are most likely to be localized hypogean species that are not found in open flowing waters (Stanford et al. 1994), and are therefore not accessible to salmonids, the flux of useable nutrients from the hyporheic zone to areas of upwelling in the river can support the base of the food chain and eventually invertebrates preyed on by stream-dwelling fishes. Ultimately, it remains unknown what effect the existing ponds have had on the hyporheic faunal invertebrate community as subsurface flows enter the ponds and become surface water until it again goes subsurface on the downstream side of the ponds. It is also unknown what effect the created wetlands will have on hyporheic processes.

Since Dean Creek is a small, intermittent stream and lacks a well-defined floodplain in the reach adjacent to the Daybreak site, its hyporheic zone is likely to be limited to vertical and lateral exchange of channel and subsurface water in near-channel sediments (Woessner 2000). Perched groundwater flow (groundwater that is not in a direct hydraulic connection with the local water table) in upper Dean Creek is likely to be partially controlled by the depositional pattern of the subsurface gravels. The alluvial fan of Dean Creek, which originates at the J. A. Moore Road crossing, would support a dominant north-south subsurface flow. The preponderance of well-graded, highly permeable cobbles and gravel in the stream bed downstream of the bridge provide an ideal setting for infiltration of surface flow near the bridge, downstream hyporheic flow through the riffle, and upwelling in the lower portion of this section of the stream (Stanford and Ward 1993; White 1993). This vertical exchange of surface and hyporheic flow is probably most important during winter, when stream flow in Dean Creek is highest. During late summer, the channel through most of the upper reach is dry, because the highly permeable channel substrate does not retain the small flow entering the reach below the bridge. As this surface flow reaches the groundwater table, its contribution is small relative to the volume of groundwater (flowing from the uplands), and consequently it no longer would be considered hyporheic flow unless it upwells into the lower reach of Dean Creek.

Finer-grained sediments dominate the east-west section of Dean Creek's streambed where the stream takes on the characteristics of a palustrine channel. The hydraulic conductivity or permeability of this streambed is significantly lower than the cobbles and gravel upstream. This reduces the potential for advective (horizontal) subsurface flow and consequently the extent of the hyporheic zone. This section of the stream also has an increased accumulation of small organic material in the streambed, which probably increases oxygen demand and decreases the biological productivity within the limited hyporheic zone. In summary, there should be no effects to the hyporheic zone of Dean Creek.

3.5.1.2 Groundwater Quality

Temperature

Continuous recorder data from the irrigation well north of Pond 1, East Fork Lewis River and the two piezometers installed south and southwest of Pond 5 provide a graphic depiction of seasonal temperature fluctuations in groundwater upgradient of the ponds as well as in the East Fork Lewis River and in downgradient water in the hyporheic zone (Figure 3-12). The temperature in the upgradient well remains relatively constant, that is, between 10 and 12° C, throughout the year. On the other hand, water temperatures in piezometers PZ-2 and PZ-3 tend to fluctuate over a range of 5 and 23° C respectively, and generally follow the trend in the river temperature as would be expected in an area affected by advective flow. Although water temperatures in the hyporheic wells follow the same general temperature trend as in the river, the water temperatures below ground are 11 and 9° C cooler than during mid-August low flow when river water temperatures are the warmest. By late September and early October, the river temperature falls below the groundwater temperature with a subsequent decline in the temperatures recorded in the piezometers, primarily due to advective flow effects.

Other Water Quality Parameters

Flow paths indicate that potential hyporheic flows from the site migrate through the existing ponds; therefore, changes in hyporheic biogeochemical or faunal characteristics from the site are expected to be similar to what is currently observed at the site. Fecal coliform levels, turbidity, pH, and dissolved oxygen content of water entering the groundwater from ponds is unlikely to have any effect on the water quality of the East Fork Lewis River or Dean Creek. Only temperature was identified as varying from readings identified in the surface waters into which the site's groundwater flows, with the temperature of the groundwater downgradient from the ponds being lower than the East Fork Lewis River during late summer.

3.5.2 Effects and Mitigation of Alternative A-1 on Groundwater: Partition the property into 20-acre parcels and sell as rural residential/agricultural tracts

Because no alteration to the topography of the site is anticipated under Alternative A-1, only limited effects to the hydrogeology of the site are expected.

3.5.2.1 Effects on Hydrogeology, Groundwater Flow Systems and Groundwater Quantity for Alternative A-1

Under Alternative A-1, flow systems and local occurrence of ground water are expected to be relatively unaffected with respect to baseline conditions. One exception might be local diversion of potential infiltration of precipitation due to the addition of impermeable surfaces from new structures and driveways.

Groundwater Use

Development of the property for rural residential and agricultural uses is likely to result in increased groundwater withdrawals from the aquifer, compared with existing conditions. Existing irrigation rights may be transferred to any new agricultural uses that would result from the development of the property into 14 20-acre tracts. Each parcel would likely be served by an individual well or wells. Water uses would include domestic consumption, irrigation, and livestock watering. Existing water rights could be transferred on a proportional basis from the current tracts to the 14 tracts resulting from partitioning under this alternative. Alternatively, these rights could be sold to others in the basin. If this transfer were to occur to other properties, each of the parcels resulting from the partitioning could withdraw up to 5,000 gallons per day without a water right. This would allow up to the 14 tracts to withdraw, cumulatively, 70,000 gallons per day on the site, plus the potential withdrawal of groundwater up to the volume of the existing rights elsewhere in the basin. Given the productivity of the local aquifers, this withdrawal rate would not be expected to have a significant adverse effect on local groundwater flow or temperature. Ecology has recently been funded to expedite the transfer of water rights throughout the state. Sale and transfer of water rights is a common occurrence, with utilities often buying the rights. Prices vary, but a value of $1,500 per acre-foot is assumed in the final HCP. Storedahl currently holds 330 afy of very senior rights with a value of $495,000. Adding the 14 dwellings with an exempt right of 70,000 gpd would equate to additional 78 afy in withdrawal from the basin.

Groundwater/Surface Water Connections

Development of the site under Alternative A-1 would result in no significant local changes in the groundwater-surface water connections, relative to existing or baseline conditions.

Hyporheic Zone

Rural residential development of the site will have no direct effect on hyporheic flow. However, the quality of the hyporheic flow may be altered as a result of infiltrating septic discharges, fertilizers, herbicides and/or pesticides common to rural residential practices as discussed in the following section.

3.5.2.2 Effects on Groundwater Quality for Alternative A-1

Temperature

The temperature of the groundwater is not expected to be affected as a result of development under Alternative A-1 relative to existing or baseline conditions.

Other Water Quality Parameters

Groundwater concentrations of dissolved oxygen and pH are not expected to be affected by the proposed development under Alternative A-1 with respect to existing or baseline conditions.

Development of the property into low-density rural residential or small farm tracts is likely to result in an increased use of herbicides and pesticides on the property. Domestic septic systems, fertilizers applied to gardens and pastures, and animal manure could increase the nutrient and fecal coliform loading rates to the groundwater. In particular, nitrogen-loading rates could increase, and highly mobile nitrates could migrate to the groundwater through the permeable soils. However, increased herbicide, pesticide, nutrient and coliform loading rates are not likely to result in a measurable effect as compared to existing conditions provided each individual landowner applies best management practices.

3.5.2.3 Mitigation for Groundwater Quantity and Quality for Alternative A-1

No mitigation for protection of groundwater quality or quantities is proposed under Alternative A-1.

3.5.3 Effects and Mitigation of Alternative A-2 on Groundwater: Mine with no ITP

Alternative A-2 would result in the excavation of new ponds and the ultimate partitioning of the property into seven to ten tracts for rural residential use. Consequently, there would be some changes in the groundwater conditions relative to the existing or baseline conditions.

3.5.3.1 Effects on Hydrogeology, Groundwater Flow Systems and Quantity for Alternative A-2

Creation of the new mine reclamation ponds would not have a significant effect on groundwater flow. The new ponds would be primarily located upgradient of the existing ponds, which effectively intercept all upgradient water. Although the perimeter of the ponds would increase under the proposal, the new ponds, which would be located upgradient, would be expected to intercept the same groundwater as the existing ponds (Figures 3-16 and 3-17 compared to 3-20 and 3-21).

Groundwater Use

Under Alternative A-2, the sale or transfer of existing water rights, installation of additional single domestic water supply wells to serve the post reclamation partitioned parcels, and the added evaporation from the new ponds would effectively increase the net amount of groundwater loss at the site. However, the local availability of groundwater supply to wells from the highly prolific shallow aquifer would not be significantly reduced.

A water balance developed from groundwater flow patterns and hydraulic calculations shows that groundwater flow into the ponds would, essentially, be the same for proposed future conditions as what is existing at the site today. Since the ponds would not be dewatered to excavate gravel, incident precipitation and groundwater would continuously flow into the excavation. Consequently, the groundwater elevation near the excavation would not drop significantly during mining or reclamation activities. The extremely high hydraulic conductivity of the shallow alluvial aquifer and the limited volume of gravel removed on a daily basis would allow the water table to equilibrate rapidly. Completed pond excavations would fill with water to approximately the level of the groundwater table associated with the shallow alluvial aquifer. Therefore, the hydraulic gradient across the site would not change significantly and groundwater flow rates would not be affected.

The seasonal variation in hydraulic gradient from the ponds to the aquifer is small relative to the hydraulic gradient between the ponds and the East Fork Lewis River (Figures 3-16 and 3-17). Therefore, seasonal variations in seepage from the ponds to the alluvial aquifer are also small. Downgradient seepage, as occurs now, would depend on local variations in the hydraulic conductivity of material on the downgradient (western) edge of the existing ponds, the elevation of the outlet control-structure, and hydraulic conditions in Dean Creek downstream of the outlet (for example, location and height of the beaver dams). Future seepage rates from the ponds and surface-water discharge rates would be similar to existing conditions.

The larger pond area would result in a greater water loss from the ponds by evaporation during the summer. However, the increased water loss by open-water evaporation from the future ponds would be offset locally by eliminating irrigation on the pastureland. Evapotranspiration from the pastureland during the irrigation season was calculated using the Thornthwaite-Mather method and evaporation data from the North Willamette experiment station (AgriMet 2000). The calculated evapotranspiration rate for the existing hay fields was similar to published estimates of consumptive-use and net irrigation requirements for hay crops in the region. Water use by irrigation was calculated for weather conditions typical of the site and for common irrigation practices (Irrigation Association 1983; Israelson and Hansen 1965). If however, the existing water rights were sold or transferred in association with development of rural tracts after mining and reclamation is complete, there would be a more than 2x increase in the effective loss of groundwater within the basin due to the additional evaporation. Following partitioning and sale of the reclaimed site, there would likely be additional groundwater withdrawal from individual domestic wells, which would be drilled to serve each resultant rural residential tract. Additional incident precipitation to the new ponds could increase surface and possibly groundwater outflows in the winter.

Overall, hydrologic analysis shows that development of additional ponds resulting from expanded mining activity would not measurably affect local groundwater contributions to the East Fork Lewis River due to the relatively minor contribution of groundwater from the site. The amount of water lost in the basin as a result of development would increase by more than double as a result of transferring irrigation water rights, installation of seven to ten exempt single domestic wells, and the added evaporation from new ponds.

Groundwater/Surface Water Connections

Under Alternative A-2, five new ponds would be created upgradient north of the existing ponds. These ponds would intercept the same groundwater flow as the existing ponds, albeit upgradient of the existing ponds. Both surface water overflow and groundwater seepage would pass from the upgradient ponds to the existing ponds. During the winter months, there would be surface and groundwater discharge from Pond 5, the most downgradient of the existing ponds; during summer months, water leaving Pond 5 would be primarily from groundwater seepage. The winter surface drainage could increase somewhat due to the increased surface area with the new ponds and consequent increase in direct precipitation recharging the ponds.

Hyporheic Zone

Hyporheic flow under Alternative A-2 will be similar to the existing or baseline conditions, with the existing Pond 1 intercepting flow from upgradient and the majority of hyporheic discharge downgradient of Pond 5. Post-project hyporheic flow, as a component of sub-surface flow, would follow patterns described above for groundwater (Figures 3-16 and 3-17). Since groundwater flow patterns would remain essentially the same as pre-project because post mining pond elevations would approximate those under existing conditions and Alternative C (Figures 3-20 and 3-21), the only newly excavated area expected to affect hyporheic flow would be the shallow created wetlands in the area east of the existing ponds (that is, Phases 1D, 2A, 2B and 2C). On the basis of the predicted groundwater flow paths, hyporheic flow from the eastern portion of the mine expansion area would subsequently flow primarily into the existing ponds, as it does currently. Groundwater intercepted by the remainder of the proposed ponds primarily comes from upland sources and thus would not be hyporheic.

The proposed ponds could potentially affect a variety of hyporheic zone characteristics. Water temperature in the hyporheic zone could increase in summer due to a greater surface area of the new ponds. As an example, non-hyporheic groundwater temperatures are fairly constant, ranging from 10 to 12° C at the irrigation well north of Pond 1.

From November 2000 through December 2001, the temperature of hyporheic groundwater at Piezometer PZ-2, which is located in the floodplain of the East Fork Lewis River in an area outside the influence of the ponds, ranged from 9 to 14° C. Notably, Figure 3-12 shows the hyporheic flow influences on the temperature of groundwater at this station during November 2000. Piezometer PZ-3, which is located downgradient from Pond 5 at its southwest corner, had groundwater temperatures ranging from 5.5 to 17° C over the same period. The rapid drop in the groundwater temperature in November and December 2000 parallels the river changes and demonstrates hyporheic effects. The temperature variations in the piezometers fluctuate over a range of 5 and 12° C, respectively, and the river fluctuates from 2.5 to 25.5° C, that is, 23° C, during the same time period. The piezometers generally follow the temperature trends in the river, albeit with a dampened response. On the other hand, the upgradient well remains relatively stable with temperatures ranging from 10 to 12° C over this period of record. Interception of hyporheic flow could affect biogeochemical processes and the distribution of interstitial invertebrates down gradient from the new ponds. However, since the flow paths indicate that flow from the new ponds would be into the existing ponds, the new ponds would likely have no net effect on hyporheic flows to the East Fork Lewis River as compared to current conditions.

Because mineralization in hyporheic waters is rapid relative to flow velocities, microbial activity in the hyorheos can create an enriched source of nitrate and other nutrients that then renters the stream channel as surface water (Edwards 1998). This source of nutrients can stimulate algal growth and macroinvertebrate grazing in the receiving river. Finer textured sediments used to backfill the ponds for wetland creation could reduce localized exchange between hyporheic and surface waters (Triska et al. 1989). This could result in a reduced amount of dissolved and particulate organic carbon, nitrogen, phosphorous, and oxygen flowing into the hyporheic zone and a resultant decrease in organic matter decomposition and oxygen consumption by benthic microbes in the hyporheic waters. As a result, levels of subsurface dissolved oxygen would probably be lower, which in turn could result in higher denitrification rates (removal of nitrogen from the ecosystem in gaseous form). However, this localized reduction in nutrient inputs due to fine sediments, would likely be offset by an increased input of nitrogen and carbon into the hyporheic waters due to the high natural productivity of the wetlands, which will be created within the existing and proposed ponds.

Under current conditions, there is often no surface flow during the summer in the north-south upper reach of Dean Creek on the project site. Alternative A-2 would not change this condition and, therefore, no significant adverse impacts to groundwater would be expected.

3.5.3.2 Effects on Groundwater Quality for Alternative A-2

Temperature

Under Alternative A-2, the temperature of groundwater immediately downgradient of the site ponds could increase slightly during the summer as a result of warmer pond water seeping into the aquifer. However, seepage rates from the ponds are relatively low with respect to East Fork Lewis River flows, and dispersion and mixing of pond seepage with ambient groundwater, heat loss to the aquifer matrix, and thermal stratification in the ponds would greatly restrict potential temperature effects to groundwater. Therefore, possible temperature changes to groundwater would likely not be measurable as compared to existing conditions. Furthermore, the direction and rate of flow indicate that there would be no measurable increase in temperature in the East Fork Lewis River from groundwater seepage. The calculated seepage from the ponds is relatively constant at 0.9 cfs, while the mean discharge in the East Fork Lewis River during August is 108 cfs. Note also the time of travel discussed in the final HCP Section 3.1.5.1 is such that any summer warmed water would arrive in the East Fork Lewis River well after summer maximum temperatures. As noted above, the advective flow from the river into the hyporheic zone act to warm or chill the hyporheic groundwater, albeit at a slower rate due to the seepage velocity and with the dampening effects of the alluvial matrix. This conclusion is supported by monitoring data from Piezometers PZ-2 and PZ-3 located between the East Fork Lewis River and Pond 5. (Figures 3-12 and 3-17).

Other Groundwater Parameters

Groundwater quality would not be significantly affected during mining activities as proposed for Alternative A-2. The proposal would eliminate any fertilizer or manure spreading on the presently cultivated hay and cornfields. However, some fertilizers could be used to enhance reclamation plantings, but application rates would be low. There could be some increase in nutrients in the groundwater due to the post-reclamation partitioning of the property to create rural residential building sites within the pond system. Septic effluent, fertilizer, herbicides and pesticides commonly used or generated by residents could directly infiltrate to the aquifer, or enter the ponds via runoff and subsequently seep into the aquifer. However, assuming that the post reclamation partitioning and low-density rural residential development followed appropriate drainfield siting and maintenance practices, as well as fertilizer application rates on lawns and gardens, there would not be a significant contribution of nutrients from this source.

Therefore, nutrient loading to the ponds or leaching of nutrients from planting areas to the groundwater would be limited.

Alternative A-2 includes the continued use of the existing ponds for the treatment of process and stormwater, including the employment of additives to accelerate settling of fine-grained materials. Extensive whole effluent bioassay testing of the additives employed to enhance settling of silt and clay in the ponds has demonstrated no toxicity to the macroinvertabrates and rainbow trout used in the testing. For a complete discussion and analysis of the bioassay testing, see final HCP, Section 3.1.5.3. Briefly, the additives field-tested were NALCO 7888 in conjunction with NALCO 9806, Calgon Catfoc4900, Catfloc L, and Pol E-Z 7736, and Poly Alum 60 and Photafloc 1133. Toxicity tests were performed on the treated process water for each additive. Testing was performed in accordance with the applicable procedures defined in Chapter 173-205 Washington Administrative Code, Whole Effluent Toxicity Testing and Limits. Acute toxicity tests were performed using rainbow trout (*Oncorhynchus mykiss*) and *Daphnia magna* or *Ceriodaphnia dubia* by a laboratory certified by the Washington Department of Ecology. These additives bind to the settled particles and, therefore, are not a conservative water coincident contaminant that moves freely through the aquifer and are not expected to effect groundwater quality.

Seepage from the ponds would not measurably affect turbidity in groundwater. As water moves through the pond system, sediments suspended in the pond water would settle to the bottoms of the ponds. The accumulated sediments would restrict migration of suspended and colloidal particles from the ponds to the groundwater. Suspended and colloidal solids do not readily migrate in most aquifers (Ecology, 1998). Furthermore, the turbidity levels in Pond 5, the most downgradient of the ponds, has been maintained at levels averaging 8.5 NTU, and periodically at or below the East Fork Lewis River water quality criterion of 5.5 NTU with the use of additives to accelerate settling of suspended solids.

Included in the processing area are a 15,000 gallon double-walled diesel tank and a 1,000 gallon doubled walled gasoline tank used to fuel on-site equipment and trucks. These tanks sit on concrete slab that includes oil-water separators and are inspected regularly. There is some potential for the accidental release of fuel or lubricants from these tanks and equipment operating at the site. Management of these materials is covered under the facility's existing Spill Prevention Control and Countermeasures Plan (SPCC). These materials are generally light, non-aqueous phase liquids and "float" or are adsorbed by the soil. Spills or releases are readily recovered by excavation of contaminated soil and/or the use of sorbent booms, skimmers or other readily available means, limiting their potential infiltration into the aquifer.

3.5.3.3 Mitigation for Groundwater Quantity and Quality for Alternative A-2

Impacts of Alternative A-2 on groundwater quality would be insignificant relative to baseline conditions. Therefore, no mitigation measures for groundwater quality are proposed. No drinking water wells have been identified downgradient of the site. However, it is Storedahl's policy to immediately respond and evaluate any report of reduced well production or well failure that may be a result of mining activities at their sites. Appropriate actions would be undertaken to repair or replace any water supply well that fails as a result of nearby mining activities by redeveloping the well, purging it of sediments, increasing its depth, or taking other necessary action, such as replacing the well.

As noted above, whole effluent bioassay testing has shown no toxicity to macroinvertebrates or rainbow trout as a result of using additives to accelerate settling of suspended solids. Storedahl's current SPCC provides controls and response actions for any release of light non-aqueous phase liquids (that is, petroleum based fuels, lubricants, or cleaning agents).

3.5.4 Effects and Mitigation of Alternative B on Groundwater: Preferred Alternative

Alternative B is physically similar to Alternative A-2, except that the resulting pond area is reduced from 149 to 102 acres due to a reduced area proposed for excavation and the reconfiguration of the existing ponds under Alternative B. Additionally, the proposed final use is fish and wildlife habitat under Alternative B, as opposed to low-density rural residential development under Alternative A-2. These differences result in some relatively minor local variances in the potential effects to groundwater.

3.5.4.1 Effects on Hydrogeology, Groundwater Flow Systems and Groundwater Quantity for Alternative B

Under Alternative B, the proposed actions potentially affecting groundwater flow and quantity are similar to Alternative A-2, with two notable exceptions. The reconfiguration of the existing ponds might result in the refraction of some of the groundwater flow now entering Pond 1 from the west, that is, the upgradient side, toward the East Fork Lewis River, due to the relatively finer grained materials proposed for backfilling the pond. This refraction and reduced seepage into Pond 1 could increase the volume, albeit slightly, of hyporheic flow within the hydrologic floodplain area. Also, implementation of a 'closed-loop' treatment system, consuming less water, and ultimate donation of the existing water rights to the State Water Trust for augmentation of in-stream flow will result in a greater quantity of groundwater for recharge of the East Fork Lewis River.

Groundwater Use

Under Alternative B, the agricultural irrigation now taking place would cease and there will be no rural residential development on the site. The groundwater rights attendant to the property would be donated to the State Water Trust for augmentation of instream flow in the East Fork Lewis River and Dean Creek. This would result in a greater volume of groundwater available for stream recharge relative to the existing or baseline conditions and to Alternatives A-1, A-2 and C.

Groundwater/Surface Water Connections

Alternative B effects to groundwater/surface water connections would be similar to Alternative A-2. Minor exceptions might be the potential refraction of flow toward the East Fork Lewis River upgradient of Pond 1, as discussed above, and a seasonal increase in the downgradient seepage from Pond 5 as a result of the storage of water in Pond 5 for low flow augmentation of Dean Creek.

Hyporheic Zone

Potential effects to the hyporheic zone under Alternative B are similar to those under Alternative A-2. As with A-2 there is the potential for localized reductions in nutrient inputs due to the fine-grained sediments in the ponds. Like Alternative A-2, this localized reduction in nutrient inputs due to fine sediments, would likely be offset by an increased input of nitrogen and carbon into the hyporheic waters, due to the high natural productivity of wetlands, which will be created within the existing and proposed ponds. However, Alternative B includes more extensive reforestation than Alternative A-2, with native species throughout the site, which should improve nutrient inputs to the hyporeheos. Specifically, nitrogen, which limits primary production in many Pacific coastal streams, can be fixed by a bacterium growing in the roots of red alder in excess of the tree's growth needs (Edwards 1998). The proposed increased area of native-valley bottom forest, which includes red alder, can act as a source of nitrogen for the hyporheos and, ultimately, the East Fork Lewis River. Under Alternative B, there is also the potential for refracted flow upgradient of Pond 1, as discussed above. See Figures 3-22 and 3-23.

During the summer months, there is often no surface flow in the upper reach of Dean Creek, downstream of the J.A Moore Road Bridge. The lack of surface flow in this reach is related to aggradation, or the deposition of cobbles and gravel in this reach due to the rapid break in slope of the streambed. Past mining at the site has occurred several hundred feet down gradient, and there does not appear nor is it reasonable to expect a causal effect between mining and the lack of flow in Dean Creek during the late summer. Under Alternative B, additional pumping into the creek (See final HCP Section 4.2.2 - Water Management Plan) would augment any summer hyporheic flow in that stream. This additional hyporheic flow would benefit riparian plants along Dean Creek and may contribute to surface flow downstream. In turn, enhanced riparian vegetation may affect characteristics of hyporheic flow, particularly by uptake of solutes (a dissolved substance) thereby reducing pollution loads, as noted by Stanford and Ward (1993). Please see final HCP Sections 6.2.1 through 6.2.3 for additional discussion of the potential impact of the expanded and reclaimed Daybreak ponds on groundwater and hyporheic flow to the East Fork Lewis River.

3.5.4.2 Effects on Groundwater Quality for Alternative B

Temperature

Temperature effects to groundwater under Alternative B are expected to be similar to Alternative A-2.

Other Water Quality Parameters

Dissolved oxygen and pH effects under Alternative B are expected to be similar to Alternative A-2. Nutrient and possibly fecal coliform introductions to the aquifer would be reduced relative to Alternative A-2, since there would not be low-density rural residential development on the post-reclamation site. In addition, there would not be an exposure to chemical additives in the discharge water, due to the use of a 'closed-loop' clarifier under Alternative B, as opposed to continued use of the ponds for treatment and settling of process and storm water under Alternative A-2.

3.5.4.3 Mitigation for Groundwater Quantity and Quality for Alternative B

Although there is not expected to be any significant adverse effect to groundwater resources from mining activities, under Alternative B, over the life of the mine, Storedahl would, as noted in the final HCP, donate its existing water rights to the State Water Trust for enhancement of in-stream flows along the East Fork Lewis River and Dean Creek, and there would be no addition of single domestic water wells to support post-partitioning low-density rural residential development. In this respect, regional groundwater resources would be protected and improved in perpetuity.

3.5.5 Effects and Mitigation for Alternative C on Groundwater: July 2000 HCP

Environmental effects and mitigation measures associated with Alternative C are expected to be similar to those discussed for Alternative B. Alternative C would result in a larger pond area than Alternative B, that is, 133 acres, as compared to 102 acres, but a reduced pond area, i.e., 133 acres, as compared to 149 acres under Alternative A-2. Under Alternative C, the property would not be partitioned for low-density rural residential use, as it would under Alternative A-2.

3.5.5.1 Effects on Hydrogeology, Groundwater Flow Systems and Groundwater Quantity for Alternative C

Effects on groundwater under Alternative C would be effectively the same as Alternative A-2.

Groundwater Use

Like Alternative A-2, Alternative C would result in the sale or lease of the existing water rights to other users within the basin. However, there would be no on-site use because the property would be gifted to a not-for-profit or public agency to be preserved as open space, precluding future development and the need for water wells to serve that development.

Groundwater/Surface Water Connections

Groundwater/surface water connections under Alternative C are effectively the same as under Alternative A-2.

Hyporheic Zone

Alternative C potential effects to the hyporheic zone are similar to those under Alternative A-2 with the exception of flow augmentation to Dean Creek and increased restoration with native valley-bottom forest as included in Alternative B. See Figures 3-20 and 3-21.

3.5.5.2 Effects on Groundwater Quality for Alternative C

Temperature

Potential temperature effects on groundwater under Alternative C are effectively the same as under Alternative A-2.

Other Groundwater Quality Parameters

Dissolved oxygen and pH effects to groundwater under Alternative C are similar to those under Alternative A-2. Since Alternative C does not include partitioning and low-density residential development, there is a greatly reduced likelihood of septic effluent, nutrient and herbicide/pesticide migration to the aquifer, relative to Alternative A-2.

3.5.5.3 Mitigation for Groundwater Quantity and Quality for Alternative C

Mitigation for groundwater quantity and quality under Alternative C would be similar to that under Alternative A-2. However, it would include the use of a 'closed-loop' clarification system that could improve the quality of the seepage leaving the ponds, and there would be no rural residential development and the subsequent increase in groundwater withdrawals as a result of domestic use.

3.5.6 Summary of Alternative Action Effects on Groundwater

No significant effect to local groundwater resources is expected to occur in any of the four alternatives. In the case of Alternative A-1, there is not expected to be any significant local effect on groundwater resources due to the limited amount of groundwater withdrawal by individual landowners. In the case of the three mining alternatives, no significant effect to local groundwater is expected to occur due to the proposed method of mining and reclamation, such that the water table in the area will remain relatively stable.

3.5.7 Analysis of the Cumulative Effects of the Alternative Actions on Groundwater

As opposed to the cumulative effects of the four alternatives on surface water, which were oriented to water quality, the cumulative signficant effects, if any, on groundwater would be oriented toward water quantity.

Alternative A-1 would create as many as 14 new rural residential/agricultural tracts on the subject property. Because there are no public water supply systems in this rural neighborhood, these tracts would, in all probability, be served by individual water wells with exempt rights to withdraw up to 5,000 gallons of groundwater per day for domestic use. The existing water rights attached to the property could be sold or leased to another user in the East Fork Lewis River Basin, resulting in a cumulative net increase of groundwater withdrawal in the basin. However, because the aquifer is so prolific, there should not be any adverse impacts to the regional systems or the interface with surface water.

Use of the site as described in Alternative A-2 would increase the total groundwater withdrawn or lost compared to Alternative A-1 or current conditions. Again, the water rights could be sold, 7 to 10 domestic wells installed, and the ponds created from the proposed mining would increase the volume of evaporation over current conditions, resulting in a cumulative net loss of groundwater in the basin.

Implementation of Alternatives B and C would result in cumulative impacts similar to Alternative A-2 on local groundwater flow systems. However, in neither case would there be any direct groundwater withdrawals for on-site domestic use. Both Alternatives B and C would increase evaporation because of the increased surface water area resulting from the proposed ponds. Alternative B would have a somewhat lower rate of evaporation because pond surface areas would be approximately 20 percent smaller than that of Alternative C after reclamation. However, in both cases, the resulting pond surface area would be smaller than the area historically irrigated, and thus the water loss would be reduced from current conditions. Under Alternative B, any groundwater lost to evaporation would be offset by the transfer of the subject property water rights to the Washington State Water Rights Trust, which would augment flows in the East Fork Lewis River and Dean Creek during late summer and early fall. This would result in no cumulative loss of groundwater in the basin under Alternative B. On the other hand, Alternative C does not provide for gifting the existing water rights to the State Water Rights Trust and, therefore, would result in a cumulative net loss of groundwater in the basin.

Effects to the hyporheic zone are primarily controlled by the existing ponds and are local in nature. No significant change is expected under any of the alternative scenarios. Therefore, the cumulative effects to the hyporheic zone of the East Fork Lewis River are negligible, relative to existing or baseline conditions.

3.6 Biological Environment

This section discusses fish and wildlife species and potential effects of the proposed operation and reclamation to those species, especially those that are candidate, proposed, or listed species under the Endangered Species Act (ESA). Other species that have a high potential to be affected or are considered to be at the greatest probability of being listed under the ESA in the near future are also discussed. Detailed information on the distribution, status, life history and habitat requirements of those species is provided in the final HCP (final HCP Technical Appendix A).

Section 3.6 is divided into two sub-sections. Sub-section 3.6.1 addresses the existing conditions for aquatic habitat and species present in the East Fork Lewis River, Dean Creek and the existing mine ponds. The effects of the four alternatives on these habitat areas and species are analyzed followed by the mitigation measures for each alternative. Similarly, sub-section 3.6.2 addresses the existing conditions of terrestrial habitats and species, followed by analyses of effects and a discussion of mitigation measures.

3.6.1 Fish and Aquatic Habitat

This section focuses on the fish species present in the area and the aquatic habitat conditions discussed above that are important to fish. The primary focus is on the species present in the East Fork Lewis River, although Dean Creek and the existing Daybreak ponds are also discussed as the habitat conditions for those water bodies are different.

3.6.1.1 East Fork Lewis River-- Affected Environment/Baseline Conditions

Anadromous fishes are an important component of the ecosystem of the East Fork Lewis River basin. In Pacific Northwest watersheds, anadromous fish are a critical link in the aquatic and riparian food web. Adult salmon, after rearing in the ocean, return to streams and provide ocean nutrients that enrich the food web from primary producers to top carnivores. At the top of the food web, at least 22 species of wildlife, including black bear (*Ursus americanus*), mink (*Mustela vison*), river otter (*Lutra canadensis*), and bald eagle (*Haliaeetus leucocephalus*), feed on salmon carcasses (Cederholm et al. 1989). At the base of the food web, salmon carcasses provide a large amount of nitrogen to streamside vegetation, and large amounts of carbon and nitrogen to aquatic insects and other macroinvertebrates (Bilby et al. 1996).

Fish are also a major component of the human ecosystem in the Pacific Northwest. Local salmon and steelhead harvests provide commercial, sport, subsistence, and cultural uses to people of the Lower Columbia River basin and the East Fork Lewis River.

Fish Species Present.

This EIS concentrates on eight fish species. These species were selected because of their known or probable occurrence in the East Fork Lewis River and their status as species of concern; or listed, proposed, or candidate species under the ESA.

These species include six salmonids: coho (O*ncorhynchus kisutch*), Chinook (*O. tshawytscha*), and chum salmon (*O. keta*), steelhead (*O. mykiss*), coastal cutthroat trout (*O. clarki clarki*), and bull trout (*Salvelinus confluentus*); and two petromyzontids: Pacific lamprey (*Lampetra tridentata*) and river lamprey (*L. ayresi*). Each of these species are anadromous or contain individuals with anadromous life histories. Anadromous fishes spawn in fresh water after rearing for some portion of their life in the ocean. One species, bull trout, exhibits a predominantly freshwater life history. Although bull trout are known to stray between watersheds, the existence of anadromous bull trout populations is uncertain (McPhail and Baxter 1996). Bull trout are very dependent on cold-water temperatures, and there are no known occurrences of this species in the East Fork Lewis River. Both the steelhead and coastal cutthroat trout are anadromous forms of species that also have freshwater life histories. The freshwater form of steelhead is known as rainbow trout.

Other fish species known or believed to be present in the East Fork Lewis River include native freshwater species such as minnows (*Cyprinidae*), suckers (*Catostomoidea*), and sculpins (*Cottidae*), the freshwater brook lamprey (*Lampetra richardsoni*), mountain whitefish (*Prosopium williamsoni)*,and the freshwater forms of rainbow and coastal cutthroat trout. Additionally, non-native species (introduced) known to occur in the lower Columbia River in Clark County, included largemouth bass (*Micropterus salmoides*) and smallmouth bass (*M. dolomieue*), yellow perch (*Perca flavescens*), black and white crappie (*Pomoxis spp.*), bluegill (*Lepomis macrochirus*), brown bullhead (Ameiurus neblulosus), walleye (*Stizostedion vitreum*), and channel catfish (*Ictalurus punctatus*) (WDFW 1999).

During the spring of 2000 and the summer of 2000 and 2001, snorkel surveys of the Ridgefield Pit reach were conducted by R2 Resource Consultants, in association with NMFS, USFWS, and WDFW. These surveys focused on observations of presence or absence of salmonids and non-native predators, such as smallmouth and largemouth bass and native predators, such as sculpin (*Cottus. Spp.)* and northern pikeminnow (*Ptychocheilus oregonensis*). Surveys were conducted during the day on March 29, 2000, and July 31, 2001, and during the nights of April 26, June 1, and July 13, 2001.-

During snorkel surveys, visibility generally exceeded eight feet. This relatively high clarity aided in the reliability of fish observations although pool areas deeper than eight feet were unable to be observed. The areas that were able to be observed were limited to the shallower pool and backwater margins and riffle areas. On March 29, 2000, relatively few fish were observed, and their absence was presumed to reflect the relatively cold-water conditions (9°C), which limits fish activity. During an April 26 nighttime survey, numerous juvenile Chinook salmon were observed in the shallow, low-velocity shoreline areas of the Ridgefield pits. Also common were coho salmon juveniles in the same locations. During the April survey, a Pacific lamprey was observed building a spawning nest in the riffle area adjacent to Ridgefield Pit 1. In June, the fish community was similar to that in April. The two July surveys indicated that juvenile Chinook were still found in the low-velocity shoreline areas, but that coho salmon were relatively rare, most likely due to smoltification (the process of changing from a freshwater to a saltwater form and undertaking the seaward migration). Steelhead/rainbow fry were observed in several very shallow areas (less than 3 inches deep) along the main channel during the night surveys in June and July. Non-native predators were not observed during any of the surveys in the river. The only predators seen were native northern pikeminnow and sculpin, which were most abundant during the daytime July 2001 survey. Notably, red shiner (Richardonius balteatus) were also observed, but were small and not considered a threat to salmonids.

In general, the shorelines along the Ridgefield pits contained fishes only where the water was shallower than three feet and the velocity was low. Juvenile salmon appeared to be equally abundant in all slow, shallow-water areas regardless of vegetation or substrate. Many fishes were observed over sandy areas that had a dune-ripple appearance. This habitat was more common in the lower ponds where submerged sand bars occur near the river channel. Large woody debris (LWD) accumulations were investigated during the survey for fish, and fish were present near LWD in shallow water, but not in deeper water. It is believed that LWD in the shallow areas may be used as refuge during the day, especially where it was the only cover near some of the sandy areas. Salmonid species found in the faster water areas included steelhead/rainbow (generally around 8 to 10 inches long) and juvenile whitefish.

Spawning habitat for salmonids occur in riffle habitats downstream and upstream of the Ridgefield Pit reach. The Ridgefield Pit reach is almost 100 percent pool habitat and is, therefore, not suitable for salmonid spawning. Prior to the avulsion in 1996, this reach likely contained a mixture of riffle habitat used for spawning and deeper water used for holding, although historical state-sponsored spawning surveys occurred on more upstream areas of the river. Therefore, salmon spawning use of this portion of the river is relatively undocumented. Suitable spawning gravels exist downstream of the avulsed reach for approximately 1.25 miles in the area upstream of the tidal influence zone at approximately RM 6. Salmon spawning habitat in the mainstem East Fork Lewis River is accessible to adult salmonid from this point at RM 6 up to Lucia Falls at RM 21.3. Steelhead can migrate past Lucia Falls and spawn in an additional 10 miles of river. Summer steelhead can migrate even further upstream, past Sunset Falls at RM 32.7, although Sunset Falls is the upstream-most limit for winter steelhead. Coho salmon and coastal cutthroat trout spawn between RM 6, at the limit of tidal influence, upstream to Lucia Falls, although their preferred habitat is in the smaller tributaries that drain to the river. Although rare in the river, chum salmon spawning was historically most abundant in the East Fork Lewis River in side channel habitats between RM 6 and RM 10. Chum could also potentially spawn as far upstream as Lucia Falls. Although Chinook salmon and steelhead could use the lower reaches for spawning, including the 1.25 miles downstream of the Ridgefield pits, these species typically spawn further upstream in the system. Bull trout are not believed to occur in the river. Spawning habitat for the two lamprey species are similar to that described for steelhead. Additional information on species use of the river near the project location, their life histories, and their population status is provided in Technical Appendix A to the final HCP.

Species Listed as Threatened Under the Endangered Species Act.

The evolutionarily significant units (ESU) of the Lower Columbia River steelhead, Chinook salmon, and lower Columbia chum, and the distinct population segment (DPS) of the Columbia River bull trout are listed as threatened under the ESA. The steelhead ESU was listed as threatened by the National Marine Fisheries Service under the ESA on March 19, 1998 (63 *Fed. Reg.* 13,347-13,371). The bull trout DPS was listed June 10, 1998 (63 *Fed. Reg.* 31,647-31,674). On March 24, 1999 (64 *Fed. Reg.* 14,307-14,328), Lower Columbia River Chinook salmon and Columbia River ESU chum salmon were listed as threatened under the Endangered Species Act. The East Fork Lewis River contains or potentially contains each of these fish populations.

Proposed and Candidate Species.

Southwestern Washington/Columbia River ESU coastal cutthroat trout were jointly proposed as threatened by National Marine Fisheries Service and the U.S. Fish and Wildlife Service on April 5, 1999 (64 *Fed. Reg.* 16,397-16,414). Subsequently, USFWS assumed jurisdiction and on June 26, 2002 announced the species did not warrant listing under the ESA; however, the USFWS considers coastal cutthroat trout a species of concern. It is unknown if native coho salmon still exist in the Southwestern Washington/Columbia River ESU. Currently this ESU species is a candidate for listing under the ESA.

Other Species of Interest.

Pacific and river lamprey, are considered by the USFWS to be "species of concern" and are not currently proposed for listing. "Species of concern" is an informal term that refers to those species that might be in need of concentrated conservation actions. Such conservation actions vary depending on the health of the populations and degree and types of threats. At one extreme, there may only need to be periodic monitoring of populations and threats to the species and its habitat. At the other extreme, a species may need to be listed as a Federal threatened or endangered species. Species of concern receive no legal protection and the use of the term does not necessarily mean that the species will eventually be proposed for listing as a threatened or endangered species.

3.6.1.2 Effects and Mitigation of Alternative A-1 on Fish and Aquatic Habitat: Partition the property into 20-acre parcels and sell as rural residential/agricultural tracts

Effects: The primary effects of the Alternative A-1 on the aquatic environment include the continued possibility of river avulsion through the existing mine ponds; encroachment on wildlife by people, domestic pets, and livestock; and a lost opportunity to create a complex wildlife habitat consisting of wetlands, riparian zones, and valley bottom forest. Pressure from landowners to protect their properties from erosion could result in the installation of riprap or other physical barriers. This would reduce the potential for river migration, recruitment of LWD, and avulsion of the main channel. These actions are not likely to be driven by the goals of protection or enhancement of salmonid habitat in this segment of the East Fork Lewis River.

Section 6.12 of the HCP discusses the quantification of potential take of covered fish species. With the existing, or baseline conditions, potential take of covered fish species under this and the other alternatives are primarily those effects related to an avulsion or less severe flooding of the East Fork Lewis River. These effects that could result in "take" include a reduction in spawning and rearing habitat from channel abandonment, an upstream headcut and attendant channel destabilization of upstream spawning habitat, the deposition of fine sediments on existing downstream spawning habitat and the capture of bed materials in the existing ponds reducing downstream channel stability, an increase in surface water area exposed to solar heating resulting in warmer water temperatures, predation, and stranding. Please refer to HCP Section 6.12 for additional information.

Mitigation: Other than conforming to regulations for rural residential development, no specific mitigation measures would be associated with the alternative action. Reclamation of the existing mine ponds would continue, but no comprehensive habitat enhancement would occur on the balance of the site.

3.6.1.3 Effects and Mitigation of Alternative A-2 on Fish and Aquatic Habitat: Mine without ITP

Effects: The East Fork Lewis River riverine habitat would not be directly affected by this alternative. Although an avulsion through the existing or future Daybreak ponds is unlikely, if this were to occur, the most likely location would be into Pond 1 and it would result in the largest potential adverse impacts as compared to existing conditions. Prior to such an event happening, the river would have migrated out of the Ridgefield pits and, therefore, conditions would be different than under baseline conditions, although how these conditions would be expressed in the interim is unknown. It is only possible to compare existing conditions with projected conditions based on identified potential avulsion locations. Current habitat in the river between RM 9 and RM 7 is dominated by rearing habitat. It is estimated that, within this two-mile reach of river, there is 149,890 square yards of slow, deep rearing habitat and 68,690 square yards of shallow, riffle spawning habitat. In the unlikely event of an avulsion into existing Pond 1, the amount of riffle (spawning) habitat between the current RM 9 and RM 7 would be predicted to decrease to 53,670 square yards, and, because the river would flow through the captured pond area under this scenario, the amount of pool (rearing) habitat would be predicted to increase to 337,750 square yards. Since the proposed mining footprint is separated from the East Fork Lewis River by the existing ponds, the location of the proposed mining areas would not increase the likelihood of avulsion; if an avulsion were to occur, it would have to first go through the existing ponds. The amount of time required to refill the existing ponds with fluvial sediments to the approximate elevation of the adjacent East Fork Lewis River channel bed is estimated at between 10 and 30 years. However, expanded mining would increase the total pond volume, and if an avulsion reached the proposed ponds, would increase the time required to refill both the existing and proposed ponds by 55 to 160 years, for a total of 65 to 190 years (see Technical Appendix C of the final HCP).

If the East Fork Lewis River were to avulse into existing Pond 1 at site G (Figure 3-10) the amount of spawning habitat that currently exists between RM 9 and RM 7 is projected to decrease by 22 percent. At the same time, there would be an almost threefold increase in the amount of pool habitat. The pool habitat created would be similar in function and effect to the Ridgefield pits site. Deeper, low-velocity pools and shallow embayments may provide juvenile salmonids refugia from high-velocity flows during the winter. Hiding cover in the form of large woody debris or vegetation along the channel margins is increasing at the Ridgefield site, and would improve the use of the habitat for refuge and rearing as the vegetation and LWD continues to accumulate. For years after the avulsion, the pools would remain deep enough to provide holding habitat for upstream migrating adult salmon, although increased water temperatures may cause them to avoid the site during the late summer.

An avulsion through the existing ponds at the project site could also affect salmonids by reducing the downstream migration speed of the juveniles and increasing the amount of deep, low-velocity habitat favored by predators. Downstream migrating salmonids generally move at rates that are a function of the local current velocity (Raymond 1979; Moser et al. 1991). Predatory fishes such as the native northern pike-minnow (formerly known as squawfish) prefer slow waters (Faler et al. 1988), and may be abundant if captured gravel mine ponds provide this type of habitat.

An avulsion into the existing Daybreak ponds could also release nonnative predatory fishes to the East Fork Lewis River. However, nonnative fishes are already present in the East Fork Lewis River and in the larger Columbia River system. Potential changes to travel time or predator habitat that would occur in the event of an avulsion are not expected to affect the survival of juvenile outmigrants from the East Fork Lewis River.

The existing and proposed ponds can also potentially affect predation rates through its surface water connections with the East Fork Lewis River, especially during a flood event. As reflected in Figure 3-6, water from the East Fork Lewis River can overtop its banks and backwater may enter into the downstream-most existing Daybreak ponds. Currently this backwater effect occurs at flood flows less than a 5-year return period. Reconfiguration of the western berm on the existing Pond 5 will alter this backwatering frequency so that it would only happen at flood flows at or greater than a 17-year event (See HCP Section 4.2.2). An additional potential flow path is identified that would cross two county roads (NE 269th Street and NW 61st Avenue) before flowing into the eastern edge of existing Pond 1. This split flow from the East Fork Lewis River could also potentially enter the Phase 1, 5, 6 and 7 excavations created under the expanded mining action (see Figure 3-10). Water from the river could also enter existing Ponds 4 and 5 from the west.

Flood flows greater than a 5-year return period event could allow fish in the river and in the existing ponds to use flooded terrestrial habitat for feeding and refuge. Although flooding is a natural phenomenon, after the waters recede, some transported fish could become stranded within the riparian area or in the created ponds and wetlands. High waters could also transport fish from the gravel mine ponds into the river. Although the use of the gravel ponds during or after a flood could subject juvenile salmonids to increased predation, the use of off-channel habitat, such as gravel mine ponds, can also result in increased growth and survival (Willams et al. 1997; Naiman and Bilby 1998; Bayley and Baker 2002). However, in addition to potential predation, fish that enter a pond could be susceptible to unsuitable conditions, such as high water temperatures, if they are trapped by receding floodwaters and are unable to return to the river to complete their lifecycle.

This alternative would not affect the occurrence or extent of overland flows onto the project site or the number of fish potentially transported by these flows. Overland flow is a natural occurrence, and fishes are naturally transported into both suitable and unsuitable habitat during these events. The occurrence of overland flow and numbers of fishes entering or leaving the existing ponds as a result of overland flow would not be affected by mining activities outside of the 100-year floodplain. Fishes could be adversely affected if they enter the site during high flows and are unable to get back to the East Fork Lewis River with the receding water before they complete their lifecycle. For example, fishes could be stranded on dry land, in a pond or wetland that was not connected to the river, or fish could be consumed by a predator.

The potential for take under Alternative A-2 would be similar to that described for Alternative A-1. However the likelihood of avulsion through the Daybreak site is less during the term of mining operations because structures would likely be installed to prevent or avoid an avulsion to protect the site access road.

Mitigation: Because there would be no direct effects by Alternative A-2 to the riverine habitat of the East Fork Lewis River, no specific mitigation measures would be implemented in or abutting this water body. Reclamation would include the creation of emergent wetlands and reforestation plantings, which would be limited to those areas surrounding the new ponds as defined by an approved reclamation plan. The five existing ponds would be similarly reclaimed, and the processing area would have the hard surface removed, a planting medium placed over it, and be revegetated with valley forest species.

3.6.1.4 Effects and Mitigation of Alternative B on Fish and Aquatic Habitat: Preferred Action

Effects: Environmental effects resulting from mining operations under Alternative B are not expected to have any direct effects on the East Fork Lewis River or its tributaries. However, indirect effects, which, although unlikely, were considered, and mitigation provided under this alternative. In particular, water quality and fish habitat associated with Dean Creek; control or containment of non-native, predatory fish populations; control of public access for recreational fishing; reconfiguration and infill in the existing ponds to make them “avulsion ready”; donation of existing water rights to the State Trust for enhancement of instream flow; placement of a conservation easement on the entire property; creation of an $1,000,000 endowment for management and habitat enhancement; and direct enhancement of fish habitat along the lower reaches of the East Fork Lewis River were evaluated under this proposal. Discussions associated with Dean Creek water quality and fish habitat is included below in Section 3.6.2.

As discussed in Section 3.6.1.1, factors affecting the East Fork Lewis River fish and aquatic habitats from mining activities could include:

> a reduction in water quality leaving the mining ponds;
>
> the potential introduction of non-native, predatory fishes into the system that could prey on the eight fish species covered by the HCP/ITP;
>
> stranding of fishes in the existing ponds or proposed ponds following flood flows; altered amounts and quality of rearing and spawning habitat following a potential avulsion;
>
> a potential increase in uncontrolled recreational fishing along this river segment which, in turn, could lead to increased fishing impacts on salmonids; and
>
> adverse effects to shallow cobble areas due to an increase in foot traffic.

Analysis of the current Daybreak site does not indicate that a potential increase in recreational fishing and its effects are likely to occur during normal operation. Indeed, the preferred alternative proposes mitigation measures that would offer significant benefits to fishes and aquatic habitat, both on- and off-site, thereby offsetting some of the negative effects associated with the recreational fishing activities during the course of mining operations.

Similar to the design under Alternative A-2, as discussed in Section 3.6.1.3, storm events are not likely to increase the potential for the effects related to overland flow to occur on such a level as to jeopardize the aquatic health of the lower East Fork Lewis River. Notwithstanding, a variety of mitigation measures would be implemented to ensure that impacts are mitigated to a level below that which is considered significant.

The potential for take would be as described in Alternative A-1 above with the addition of effects from collecting and capturing fish stranded during an avulsion or flood event and transporting them back to the main channel (CM-09).

Mitigation: Under Alternative B, the ITP would be issued by the Services and the applicant would implement an HCP developed in cooperation and consultation with and the approval of the Services. The HCP and the associated implementing agreement establishes commitments for various habitat enhancement, conservation and preservation measures and provides a framework for a cooperative approach with local, state, and federal regulatory programs and non-profit organizations. Mitigation commitments under Alternative B specific to the East Fork Lewis River include:

- **Off-site floodplain enhancement**. In-kind resources with a value of up to $25,000/year would be committed for a period of 10 years in labor, equipment, and/or materials to support non-profit programs targeted for enhancing floodplain functions and protecting listed species along the lower East Fork Lewis River drainage. Projects would be evaluated for their eligibility to receive the funding by the Lower Columbian Fish Recovery Board, to support public or private conservation groups working to preserve or conserve fish and wildlife habitat in the lower East Fork Lewis River basin.
.
- **Conservation easement and fee-simple transfer of property**. Storedahl would commit to preserving buffer areas around the proposed mine site footprint under a conservation easement. Following reclamation of the site, the conservation easement would be extended to the Daybreak site and the property deeded to one or more public or non-profit organizations. The easement would limit, in perpetuity, the activities to which the property could be used, and would establish that it would be maintained for preservation of fish and wildlife habitat. In addition to the fee simple transfer of the property with a conservation easement, a $1,000,000 endowment would be established along with the transfer of ownership for habitat monitoring, maintenance and management.
.
- **Reconfiguration of ponds**. Reconfigure and infill the existing ponds with emergent and forested wetland margins to provide a reduction in potential negative effects in the event of an avulsion into the site.

- **Donation of water rights.** The applicant would gift existing water rights to the State Trust Water Rights Program for enhancement of instream flow in the East Fork Lewis River and Dean Creek as provided for under Ch. 90.42 RCW.

- **Control of non-native predatory fishes.** Although non-native predatory fishes would not be eliminated, several measures will work in concert to help reduce their populations and access to salmonid prey. These measures include: 1) Reconfiguration of the Pond 5 berm so there is a single outlet to Dean Creek and the frequency of backwater flood events from the East Fork Lewis River is reduced so that it would occur only at or above a 10-year event; 2) narrowing the existing Ponds 1, 2, 3, and 4 (thereby reducing available habitat and limiting the potential abundance of large predatory fish); 3) planned harvesting of non-native largemouth bass on 5-year intervals; 4) installation of rock barriers between the ponds to further restrict fish movement; and 5) placement of educational signs along the pond edges to inform public users of the dangers of releasing non-native fishes into the ponds or into the adjacent streams and rivers.

- **Controlled public access.** Unnecessary roads associated with the existing Daybreak facilities would be removed and replanted to prevent vehicular traffic from entering onto the property. Where necessary, vehicular barriers would be installed to further prevent motorized vehicles from entering the property and creating erosion control problems. Foot trails would be installed to encourage the public to access the East Fork Lewis River at selected locations and to prevent riparian areas along this river stretch from being damaged by foot traffic.

The effects noted above relate primarily to existing conditions. The potential for and magnitude of adverse effects that may occur under the existing, baseline conditions would be significantly reduced, but not necessarily eliminated, following implementation of the HCP's conservation measures. As noted above, the conservation measures are designed either to (i) ameliorate or minimize potential adverse effects arising from existing, baseline site conditions, or (ii) avoid take, or minimize and mitigate the impact of take to the maximum extent practicable, that may arise from covered activities. HCP Sections 6.2 through 6.11 provides detailed information regarding the potential effects of the preferred alternative activities on each of the covered species, at each of their major life stages.

An indirect beneficial consequence of the preferred alternative would be improved habitat productivity within the area. Isolated ponds connected to rivers can provide valuable rearing habitat for Pacific salmonids (Everest et al. 1987, Bryant 1988, Reves et al. 1991, Richards et al. 1992, Reiser et al. 1992.) and off-channel habitat is a limiting factor for salmon and steelhead production in the East Fork Lewis River (WCC 2000). Conservation measures to provide flooded terrestrial habitats around the ponds and off-channel habitat that is connected to the river is expected to benefit the recover of ecosystem functions important to all of the covered species.

3.6.1.5 Effects and Mitigation of Alternative C on Fish and Aquatic Habitat: July 2000 HCP

Effects: Environmental effects on the East Fork Lewis River and its tributaries associated with Alternative C, including the potential for take, are expected to be similar to those discussed in Alternative B. Mitigation efforts focused on prevention of indirect effects associated with the proposed mining activities; however, would be limited compared to those discussed for Alternative B.

Mitigation: Measures proposed for Alternative C to reduce the potential of interactions of predatory fishes with the covered species include the construction of a fish access barrier between Pond 5 and Dean Creek, and placement of educational signs along the pond edges. The fish access barrier would be effective only during flows less than a 17 year event (see HCP Section 4.2.2). Under this alternative, the ponds would not be narrowed as they would under the preferred alternative, with the resulting reduction in large mouth bass habitat. Similarly, there would be no large mouth bass targeted harvest. Control of public access would be limited to minimizing, but not preventing or controlling the location of vehicular and foot traffic into riparian areas. Under Alternative C, establishment of a conservation easement restricting use of the property would not be granted under this proposal, although the site would still be available for fee transfer and management by a public or non-profit organization upon completion of mining activities. Similarly, monies would not be provided for use on off-site riparian enhancement projects associated with the lower East Fork Lewis River watershed.

Because this alternative does not include the full array of conservation and mitigation measures included in Alternative B, the reduction of adverse effects that may occur relative to baseline conditions would be expected to be less so than under the preferred alternative. For example, without infill and reconfiguration f the existing ponds, the time for recovery would likely remain three decades as opposed to five years under Alternative B. Additionally, the potential for extensive headcutting projected under existing baseline conditions would likeky not be significantly reduced. Again, please refer to Section 6.12 of the HCP for more information.

3.6.2 Dean Creek-- Affected Environment/Baseline Conditions

Dean Creek is potentially accessible to several anadromous salmonids including coho salmon, steelhead, and coastal cutthroat trout. A November 1991 stream survey found coastal cutthroat and rainbow trout, largescale sucker, and sculpin (EnviroScience 1996). Access to Dean Creek is limited in the lower reach by beaver dam building throughout the lower 0.5 miles. This reach and the reach above this that flows adjacent to the Daybreak site lacks shade and habitat complexity due to the absence of riparian vegetation and recruitable large woody debris. The banks are severely eroded in places due to lack of vegetation and livestock trampling. For approximately 1,350 feet downstream of the J.A. Moore Road, flows are subsurface during the summer, due at least in part to the natural accumulation of gravel near the road crossing.

As mentioned in Section 3.5.1.1, the hyporheic zone associated with Dean Creek at the upstream boundary of the project site is likely limited to vertical and lateral exchange of channel and subsurface water in near-channel sediments during winter, when stream flow in Dean Creek is highest. In the lower reach of Dean Creek, the hydraulic conductivity (permeability) of the streambed is reduced due to the natural palustrine nature of the streambed, which would also limit the extent of a potential hyporheic zone associated with Dean Creek. No impacts are anticipated to occur to Dean Creek's hyporheic zone and therefore no mitigation is proposed.

3.6.2.1 Effects and Mitigation of all Alternatives

Because Dean Creek is a tributary to the East Fork Lewis River that shares some of the same fish species, fish and aquatic habitat effects in Dean Creek resulting from each alternative are expected to be similar to those discussed in Section 3.6.1.4 for the East Fork Lewis River. Mitigation measures specific to enhancing fish and aquatic habitat associated with Dean Creek are discussed below for each Alternative.

Mitigation Proposed for Alternative A-1: No mitigation is proposed for protection or enhancement of Dean Creek under Alternative A-1.

Mitigation Proposed for Alternative A-2: Under Alternative A-2, mining activity would likely take place no closer to Dean Creek than 50-feet. A setback berm would be constructed in the outer 10 feet of this 50-foot strip. This setback berm would eliminate or reduce the likelihood of Dean Creek avulsing into the Daybreak ponds although it would also limit the potential extent of channel migration. Restored riparian forest along the eastern bank of Dean Creek will mitigate for some of this potential lost opportunity, by providing a source of LWD, increased shade, and stream channel complexity.

Mitigation Proposed for Alternative B: In addition to those mitigation measures identified in Section 3.6.1.4, Alternative B would also provide for:

> **A riparian management zone on Dean Creek**. The land to the east of Dean Creek would be re-graded into a terraced floodplain that spans an inner-management zone of 75-feet from the ordinary high water mark where no mining would take place. An outer-management zone of 125 feet would be mined and then backfilled and revegetated as forested wetland to created a 200-feet wide, riparian buffer along the east side of Dean Creek. The created floodplain would also be planted with native vegetation and initially irrigated to accelerate vegetative growth. This 200-wide riparian zone would enhance salmonid habitat by allowing Dean Creek to access its floodplain, recruit LWD, and meander out of its current channelized state without migrating into the proposed excavation areas. Once revegetated, no equipment or disturbance would be allowed within 200 feet of the creek. The two-zone management area is designed to protect Dean Creek from short-term effects and provide an array of long-term riparian functions for improving salmonid habitat in the creek channel.
>
> **Channel habitat enhancement through selected reaches of Dean Creek**. After the floodplain to Dean Creek has been restored and replanted, selected segments of the reach would be enhanced with in-channel log structures. Placement and type of log structures would be approved by federal and state regulatory agencies prior to installation.
>
> **Removal of exotic vegetation**. During floodplain restoration activities, exotic (non-native) vegetation would be removed.
>
> **Flow augmentation in Dean Creek**. Flow augmentation, pumping cooler 'bottom water' from Ponds 3 and/or 5 during low flow periods would directly enhance late summer aquatic conditions in Dean Creek (see FEIS Section 3.4.4.3 and final HCP CM 04).

Mitigation Proposed for Alternative C: Mitigation for effects to the Dean Creek aquatic and riparian habitat from this alternative would be similar to those measures proposed for the preferred alternative. As discussed above, an inner 75-foot preservation zone and an outer 125-foot management zone would be created along the east bank of Dean Creek. However, in place of a re-graded floodplain terrace in the inner-management zone, a berm would be constructed to restrict the movement of Dean Creek and reduce or eliminate the likelihood of Dean Creek avulsing into the proposed mine ponds. Existing native species would be maintained between the berm and the creek. Following completion of mining in Phase 1 area parallel to the creek, an outer 125-foot segment of the management area would be backfilled and revegetated with valley bottom species.

The east bank of Dean Creek would be enhanced in areas that have excessive rates of erosion or which lack overhanging structure. Biostablization techniques using logs and rocks in concert with re-established vegetation would be initiated immediately following issuance of the ITP. Following successful bank stabilization and enhancement, channel improvements would be constructed. Site-specific designs would be developed to improve low flow habitat quality by enhancing pool scour and to enhance winter rearing habitat by increasing cover over pools. Detailed plans for large woody debris placement would be submitted to the Services and WDFW for approval prior to implementation.

3.6.3 Existing Mine Ponds -- Affected Environment/Baseline Conditions

The existing mine ponds are artificially created water bodies resulting from past mining. Four species of non-native fishes have been observed in these ponds. These species include largemouth bass, black crappie, bluegill and brown bullhead.

3.6.3.1 Effects and Mitigation of all Alternatives

Alternatives A-1 and A-2 do not provide specific mitigation measures for the protection or restoration of fisheries or aquatic habitat associated with these 5 ponds beyond what would be addressed in the existing or any future DNR reclamation plan for the facility. Alternatives B and C would provide mitigation as addressed in Section 3.6.1.4 and Section 3.6.1.5 of this report. Alternative B would include a conservation easement and a fee-simple transfer of the property, reconfiguration of the existing ponds to make them "avulsion ready," establishment of forested wetlands along the margins of the reconfigured ponds, donation of the water rights to the state land trust for augmentation of instream flows in Dean Creek, control of predatory fishes and public access, the posting of a bond to cover avulsion contingency upon initiation of the ITP, and a $1 million endowment to manage and maintain the conservation measures in perpetuity.

3.6.4 Summary of Effects of Alternative Actions on Fish and Aquatic Habitat

Relative to existing river conditions none of the four alternatives is expected to have any direct adverse impact to protected fishes or aquatic habitat, except in the unlikely event an avulsion occurs. Alternatives B and C would provide mitigative measures that would enhance the immediate riparian areas adjacent to the proposed site, which would result in an improvement to aquatic habitat over the long run.

In the unlikely event of an avulsion, fish and aquatic habitat would be affected under all four alternatives. In the case of Alternative A-1 and A-2, measures to protect improved property and land would be implemented. For example, riprap and other techniques to control river migration and erosion would likely be used. These structural techniques would limit the potential for listed aquatic species to utilize the area for spawning and rearing. In the three mining scenarios, Alternatives A-2, B and C, an avulsion could increase the potential for fishes to become stranded in the existing ponds and related wetlands and subjected to increased predation. However, under the preferred alternative these risks are reduced as a result of increased buffer widths between the existing and new mining areas and reconfiguration of the existing ponds to provide a preferred flow path for a potential avulsion. Under this alternative a potential avulsion would be most likely to follow a relic channel path through the existing ponds, avoiding potential stranding and increased predation in the actively mined areas. Under Alternatives A-2 or C the existing ponds would not be reconfigured to make them “avulsion ready” as with Alternative B.

In the event of an avulsion into the existing ponds, there would be erosion and transport of accumulated fines into the river with the magnitude of the event and proportion of river flow through the ponds determining the volume of sediment transported. An avulsion is most likely to occur during high flow or flooding, for example, from November through February. Late spawning Chinook or coho redds may be subject to scour and sedimentation as a result of high flows or flooding and an avulsion. However, conservative sediment transport analyses, assuming complete diversion of the river through the avulsed pond, show that most of the fine grained sediments from the avulsed ponds would be transported downstream beyond the spawning beds during high flow event(s) and the balance resuspended and transported out of the spawning reach in a matter of days (see Technical Appendix C, final HCP).

3.6.5 Analysis of the Cumulative Effects of the Alternative Actions on Fish and Aquatic Habitat

All four alternative actions would take place outside of the 100-year floodplain with only limited exceptions in each case. A few structures and other improvements under A-1 could locate within the regulated floodplain. If development of all lots on the project site and those up- and downstream within the 100-year floodplain and outside of the designated floodway were to occur, such development could legally increase the flood water surface elevation up to one foot under the current Clark County floodplain regulations and the FEMA flood insurance program. Under the three mining alternatives, all expanded mining activities would be well away from the East Fork Lewis River and under Alternatives B and C outside the CMZ, and separated from Dean Creek by an enhanced buffer zone. The conveyor system and a few noise attenuation berms or devices would be constructed in the floodplain in all three mining alternatives. Process water intake equipment and treatment facilities as well as portions of the conveyor system would continue to be located within the regulated floodplain, in or adjacent to the existing ponds until final reclamation is complete. Additionally, planting of vegetation to create a valley bottom forest throughout the site will also take place within portions of the floodplain.

Conversion of the subject property to low-density rural residential and agricultural tracts and land uses would be below the threshold of regulatory review because the size of the resulting tracts would be larger than the minimum for formal subdivision review. As such, there would be no opportunity for regulatory agencies to require stormwater management plans and facilities. Resulting stormwater runoff would be unmanaged and follow current patterns, albeit with changed water quality constituents as described in Section 3.4.4.1 above which would contribute to degraded water quality of the receiving water bodies, either Dean Creek or the East Fork Lewis River

The range of cumulative effects, therefore, are limited. In all cases, the potential cumulative adverse effects would be primarily related to stormwater runoff and avulsion. Measures to mitigate or control for these factors would be made to varying degrees under the three mining alternatives, but not under Alternative A-1.

Under Alternative A-2, the post reclamation rural residential development of the property would result in structural activities such as bank hardening and levees, similar to Alternative A-1, should flood, channel migration or avulsion potentially threaten improved property. This could result in up to 8,000 feet of bank hardening or levees being added to the approximately 30,000 feet of hardening currently in place between Lewisville Park and LaCenter (Wade, 2000), or an increase of over 25 percent in the lower East Fork Lewis River. These structural controls would add to the existing lost opportunities for natural channel migration and related geomorphic evolution. The likelihood of success and effectiveness of the measures is difficult to forecast, but it is apparent that the efforts would focus on property protection rather than maintenance of habitat, and certainly not on habitat enhancement. Secondary opportunities would be related to habitat enhancements, both on- and off-site. Again, the mining alternatives would pursue these activities to varying degrees, while the rural residential development alternative would not. Notably, Alternative B specifically provides for off-site habitat enhancement in partnership with others during the period of active mining. It also provides for use of accrued interest from the endowment to support preservation and enhancement in the lower East Fork Lewis River in perpetuity.

Alternative A-1 would also substantially reduce the opportunity for implementing a coordinated revegetation plan with the goal of restoring native, valley bottom forest landscape. Further, development of the 14 tracts would effectively prevent the inclusion of the site into the greenbelt through the East Fork Lewis River valley being acquired and preserved by Clark County and its partners, and thus substantially reduce the potential for generalized habitat enhancement with extra efforts focused on improving riparian and fish habitat. There would also be no efforts directed at off-site habitat enhancements within the East Fork Lewis River basin.

The cumulative effects on fishes and aquatic habitat would vary with the three mining alternatives. All would be required to follow stormwater management and erosion control plans, comply with NPDES permit standards for stormwater discharge, and meet the requirements of an approved reclamation plan, which would include sequential reclamation as each proposed mine phase is completed. The conservation or mitigation measures of Alternatives B and C would provide for fish and aquatic habitat enhancements beyond what would be required by Washington Department of Natural Resources reclamation standards currently in effect.

While all mining alternatives would meet water quality standards for discharges, under Alternative A-2 the applicant would continue to treat its process water as it has recently, with the inclusion of treatment additives and use of the ponds to settle sediments. These sediments would be excavated regularly from the primary settling channel and used for reclamation purposes. This treatment process has proven effective as discharges have approximated turbidity standards for the watershed. Implementation of the 'closed-loop' system under alternatives B and C would further improve the discharge. Materials collected from the 'closed-loop' system employed in Alternative B would result in the placement of sediments in the ponds in a specific design to reduce the potential for downstream damage in the case of an avulsion event through existing Pond 1.

All three alternatives would result in a restored and enhanced riparian area as well as aquatic habitat along Dean Creek, although Alternative B would incorporate a floodplain terrace to allow increased meander opportunities, rather than construction of a berm to restrict lateral stream movement. Both Alternatives B and C would also incorporate Dean Creek flow enhancements by pumping water from the bottom of existing ponds during low flow periods in late summer months.

Avulsion measures would be similar for Alternatives A-2 and C. Monitoring would be constant and appropriate structural and/or bio-engineered solutions employed if necessary after consultation with the appropriate regulatory agencies. Alternative B, however, would result in a reconfiguration of the existing pond system with designed backfill using imported fill as well as the sediments from the 'closed-loop' process water treatment system and the creation of forested wetlands to establish backwater channels similar to those historically found in valley bottoms.

Alternative B includes the placement of a conservation easement on the property. Under Alternatives B and C, the subject property, at the end of reclamation and enhancement, would be gifted to one or more public or not-for-profit agencies for preservation and incorporation into the East Fork Lewis River greenbelt that has been partially established. This 300 acre tract would add nearly 30 percent to the approximately 1,600 acres currently in the East Fork Lewis River greenbelt. The property is also one of the last "key links" in ensuring that the greenbelt is continuous along the north bank of the East Fork Lewis River. In addition to creating a continuous greenbelt, the restoration and reclamation on the Daybreak site would be complemented by restoration efforts taking place throughout the lower watershed, including such efforts as the floodplain reconnection on Lockwood Creek by Clark Conservation District and reforestation of the Ridgefield Pit area by Pacific Rock Environmental Enhancement Group, Inc. Under Alternative A-2, the property would not be dedicated or gifted for inclusion in the greenbelt, and thus would not formally add to the habitat system along the river. Instead, 7 to 10 tracts would be partitioned for building sites adjacent to the reclaimed ponds. This would result in discontinuity of open space along the river that could otherwise maintain habitat for fish and wildlife dependent on riparian systems.

3.6.6 Terrestrial Habitat and Wildlife

The project site is in the *Tsuga heterophylla* forest zone (Franklin and Dyrness 1973). The *Tsuga heterophylla* Forest Zone is characterized by climax western hemlock (*Tsuga heterophylla*) and western red cedar (*Thuja plicata*) forests and sub-climax Douglas-fir (*Pseudotsuga menziesii*) forests. Topography, aspect, geology, soil, and available groundwater all influence plant community patterns at the local level, particularly for understory species. Common understory species include sword fern (*Polystichum munitum*) in moist sites, salal (*Gaultheria shallon*) in dry sites, and Oregon grape (*Berberis nervosa*) in sites with intermediate status. Hardwood forests in the *Tsuga heterophylla* Forest Zone are commonly restricted to moist, early successional sites such as abandoned river channels and newly colonized gravel bars. Black cottonwood (*Populus trichocarpa*) and red alder (*Alnus rubra*) often dominate in fluvial settings, while red alder and big-leaf maple (*Acer macrophyllum*) are common in moist upland settings).

The project site is situated in a relatively narrow river valley, where fluvial disturbance and subsequent succession were important ecological processes that historically determined vegetation structure. Human disturbance has had a major effect on native vegetation in the area, which is now a mix of relatively intact native plant communities and moderately to severely disturbed plant communities. Existing habitat and vegetation types are shown in Figure 3-24 Vegetation descriptions presented here were derived from a vegetation and wildlife habitat report by EnviroScience, Inc. (1996) based on 1991 and 1996 field visits, a wetlands delineation by Ecological Land Services, Inc., (1998), spring, summer and winter 1998 site visits by R2 Resource Consultants and timber cruises of the forested areas by Ecological Land Services in the winter 2000.

3.6.6.1 Cultivated Fields-- Affected Environment/Baseline Conditions

Cultivated fields occupy the largest area of the project site, approximately 149 acres of Storedahl's 300-acre ownership. Much of the site consists of open, herbaceous-dominated vegetation used historically as pasture for dairy cattle or cultivated for silage or livestock feed. The margins and some isolated portions of the currently irrigated cultivated area include approximately 18 acres of uncultivated uplands and upland forest. An additional 20 acres is presently in active restoration.

In 1991, the vegetation within the pasture and grass fields consisted of quackgrass (*Echinocola crusgalli*), Italian rye grass (*Lolium multiflorum*), perennial rye grass (*Lolium perenne*), white clover (*trifolium repens*), Canada thistle (*Cirsium arvense*), dandelion (*Taraxacum officinale*) and mallow (*Malva neglecta*). Within the cultivated areas, alfalfa (*Medicago* sp.) and wheat (*Triticum* sp.) were dominant. In 1996, the pastures and grass fields were less diverse than when observed in 1991. The fields still contained clover, thistle and dandelion, but the grasses were almost completely dominated by Kentucky bluegrass (*Poa pratensis*). Feed corn has been grown in recent years.

The existing pasture represents moderate-value overwintering habitat for some species of birds and the pastures support small mammals (voles (*Microtus spp.*) and mice (*Peromyscus spp.*). Overwintering populations of birds currently utilizing the fields include osprey (*Pandion haliaetus*), kestrels (*Falco sparverius*), great blue herons (*Ardea herodias*), American pipits (*Anthus spinoletta*), Canada geese (*Branta canadensis*), red-tailed hawks (*Buteo jamaicensis*), and Western meadowlarks (*Sturnella neglecta*). The raptor species likely feed on mice, voles and perhaps small birds. Some of the other bird species likely feed on seeds and grasses.

3.6.6.2 Effects and Mitigation of Alternative A-1 on Terrestrial Habitat and Wildlife: Partition the property into 20-acre parcels and sell as rural residential/agricultural tracts

<u>Effects</u>: Under Alternative A-1, the cultivated area and associated uplands would be parceled into 20-acre tracts and sold to individual landowners for rural residential development and small-scale agricultural activities. Portions of the resulting 20-acre parcels are expected to remain as pastureland or small agricultural fields. The limited value of the site as terrestrial wildlife habitat under existing conditions would be further degraded as the site is developed into rural residential properties and wildlife is forced to compete with rural residential land uses and activities (e.g. presence of domestic pets and pasturing of livestock). More significantly, the opportunity to comprehensively restore and create the riverine, wetland, and forest habitats described in Alternatives B and C would be lost. Instead of the proposed wetlands, riparian zones, and valley bottom forests, the site would likely be dominated by buildings, roads, and homogeneous flat pasturelands. However, property owners would still have to adhere to shorelines, critical habitat and other regulations. Although individual property owners could voluntarily implement conservation, enhancement, and mitigation measures on each tract, there is unlikely to be any incentive to do so. Further, no comprehensive plan to restore and create wildlife habitat for the entire property would be required of individual landowners and no such plan would be likely to be proposed or implemented.

<u>Mitigation</u>: No mitigation is proposed for effects to the terrestrial environment under Alternative A-1.

3.6.6.3 Effects and Mitigation of Alternative A-2 on Terrestrial Habitat and Wildlife: Mine with no ITP

Effects: Impacts of the mine plan and operations under Alternative A-2 would negatively effect rodent populations within the pastured areas. The loss of the existing pasture does not represent a significant adverse effect as similar habitat is available within ¼ mile of the proposed project site and includes a large area of hayfield east of the site, directly adjacent to the East Fork Lewis River and west of the Daybreak Bridge. Post reclamation partitioning and development as low-density residential development would result in impacts similar to Alternative A-1.

Mitigation: Loss of the monoculture environment created by the agricultural fields would be mitigated by restoring the area, upon completion of mining activities, into a diverse mixed ecosystem containing woodland, riparian vegetation and emergent wetland habitats. Low-density rural residential development offset some of these benefits, albeit not to the extent projected for Alternative A-1.

3.6.6.4 Effects and Mitigation of Alternative B on Terrestrial Habitat and Wildlife: Preferred Alternative

Effects: Under Alternative B, mining and reclamation activities would result in operational effects similar to those described Section 3.6.6.3 for Alternative A-2, except there would be a conservation easement placed on the property, access would be controlled, and no low-density rural residential development would occur.

Mitigation: Restoring the terrestrial portions of the property in a similar fashion as described for Alternative A-2 would mitigate for loss of agricultural lands.

3.6.6.5 Effects and Mitigation of Alternative C on Terrestrial Habitat and Wildlife: July 2000 HCP

Impacts and mitigation measures for effects to the terrestrial environment are expected to be similar to those described for Alternative B.

3.6.7 Mixed Forest-- Affected Environment/Baseline Conditions

Mixed forest is found in small stands up to a few acres scattered along the northern perimeter and southeast corner of the project site (Figure 3-24). The area of existing mixed forest encompasses approximately 8 acres, occurring in 6 separate patches. In addition, a 20-acre area of disturbed mixed forest is presently being restored southwest of Bennett Road. Only a small portion (about 2 acres) of this is included in the mining plan under Alternatives A-2. The small mined area under Alternatives A-2 would be converted to high quality emergent wetlands, and the balance on this 20-acre area would remain in mixed forest. Under Alternative B, this particular tract is not included in the mining plan.

Stand A is located immediately adjacent to and northeast of Bennett Road. While small and isolated, it is somewhat structurally complex, containing large trees, gaps, wetlands, and a heavy shrub layer. Stand A is the remnant of a 60- to 80-year-old second-growth forest, with many large (most 14 to 39 inches in diameter at breast height (dbh) Douglas-fir trees. There are no trees less than 8 inches dbh. The southeast portion of the stand is mixed, containing big-leaf maple, black cottonwood, Douglas-–fir, and western red cedar. A wetland is located in this portion of the stand. Aerial photos from 1993 reveal that Stand A was part of a larger stand that extended south of Bennett Road. While the crown cover is quite high (70 to 80%) in portions of the stand, sidelight sources may explain the heavy shrub layer and relatively full crowns within the stand. One clump of three trees is detached from Stand A, located in the pasture due north.

Stand B is located along what appears to be a fence line north of Stand A. It extends westward from the eastern property boundary. Stand B has a "hedge row" of sapling bitter cherry (*Prunus emarginata*), interrupted by relatively large open crowned Douglas-fir trees greater than 25 inches dbh. This stand interrupts the open pasture. Parts of the pasture are planned for mining during Phase 2. This remnant stand may provide cover for wildlife, and serve as a seed source for future reclamation of the site.

Stand C is an extension of Stand B, extending toward the intersection of NE Bennett Road and NE 61st Avenue. The west end of the stand is adjacent to a private residence. Stand C is more complex, and larger than Stand B. The canopy of Stand C is similar to stand type 2 of Stand A. Approximately 10 large relatively full-crowned, Douglas-fir trees (approximately 20 to 30 inches dbh) dominate the stand; big-leaf maple, red alder, and bitter cherry occupy the intermediate level of the canopy. There is one Douglas-fir tree along the old fence line between Stand B and Stand C. A large, short Douglas-fir snag occurs midway through the stand. Stand C may provide higher quality habitat than Stand B.

Stand D is located in the northeast corner of the property. This stand has three stand types within it. Type 1 includes relatively dense pole-sized Douglas-fir trees, type 2 contains mixed woodlands consisting largely of hardwoods, and type 3 is a disturbed site dominated by relatively open-grown Douglas-fir.

Type 1 consists of an intermediate class of Douglas-fir poles ranging in size from 7 to 17 inches dbh. The canopy cover approaches 90 percent toward the heart of this stand type, which reduces the complexity and diversity of the shrub layer. The larger, dominant trees within this type are beginning to out-compete the smaller trees, many of which are in a state of decline. There are approximately ten to twenty small snags per acre (less than 8 inches dbh) within this stand type. This type of stand, by itself, provides relatively low quality habitat due to the lack of structural diversity, and the small tree size. Gaps and edges increase the complexity of this stand.

Type 2 is located in the northeast corner of Stand D, at the base of a steep slope. It is part of a larger stand that appears to follow the toe of the slope. The canopy within this portion of the stand is composed of black cottonwood, bitter cherry, big-leaf maple, and Douglas-fir. Type 3 is a disturbed site, with cobbles on the surface. Large, pyramid-shaped, open-grown Douglas-fir trees (15 to 25 inches dbh) dominate the canopy, while the shrub layer consists of an assemblage of non-native and native species. While species diversity may be low, Stand type 3 is more structurally complex than stand type 1, and may provide higher quality habitat.

The three major stand types described above create a relatively complex stand when Stand D is considered as a whole. There are few snags or logs greater than 8 inches in diameter within this stand type, reducing the value of the stand as habitat.

Disturbed mixed forest occupies the southeast portion of the site, southwest of Bennett Road. Aerial photographs indicate that this area was once contiguous with the mixed forest stand on the north side of Bennett Road. This area has been disturbed by logging and recreational motorcycles and bicycles and is dominated by species characteristic of disturbed areas. Scattered black cottonwood and big-leaf maple dominate the overstory. Shrubs growing on the site included snowberry (*Symphoricarpus albus*), Himalayan blackberry (*Rubus discolor*), vine maple (*Acer circinatum*), and Scot's broom (*Cytisus scoparius*). In 1999, the area south of Bennett Road was graded and planted with approximately 4,000 shrubs and trees. The planting included a mix of Douglas-fir, western red cedar, black cottonwood, big leaf maple and alder, as well as, snowberry, Nootka rose (*Rosa nutkana*), salmon–berry (*Rubus spectabilis*), salal and hazel–nut (*Corylus cornuta*) with red fescue (*Festuca arundinacea*) and fireweed (*Epilobium angustifolium*) added as herbs, in an attempt to reestablish a natural vegetative cover of native species.

Valley bottom forests such as those in riparian zone along the East Fork Lewis River on-site and off-site provide foraging, nesting, and dispersal habitat for numerous wildlife species. WDFW through its Priority Habitats and Species database program, (WDFW, 1997) performed a database review of sensitive, threatened, and endangered wildlife observations at the project site. Although no state or federal listed species were identified, the project site and adjacent lands contain important habitat for a variety of species. The forested riparian corridor along the East Fork Lewis River is identified as a priority habitat that provides "high quality habitat with multiple layered canopy" (WDFW, 1997). The wetland and forested lands adjacent to the East Fork Lewis River are mapped by WDFW as priority areas that support breeding and wintering concentrations of geese, duck, cavity nesting ducks, and wintering populations of tundra swans (*Cygnus columbianus*). This database also records breeding osprey, breeding bald eagles, and winter concentrations of sandhill cranes in the surrounding area.

Birds observed within this habitat include the American crow (*Corvus brachyrhynchos*), song sparrow (*Melospiza melodia*), American robin (*Turdus migratorius*), ruby-crowned kinglet (*Regulus calendula*), downy woodpecker (*Picoides pubescens*), black-capped (*Parus atricapillus*) and chestnut-backed chickadees (*Parus rufescens*), winter wrens (*Troglodytes troglodytes*), common raven (*Corvus corax*), rufous-sided towhee (*Pipilo erythrophthalmus*) and a belted kingfisher (*Megarceryle alcyon*). In 1991, an osprey–nest was located on a nesting platform, atop a power pole, adjacent to the river near the mining area. This and other nearby nesting platforms are currently used. According to the WDFW, there were approximately six new osprey nests along this reach of the river in 1994. A great blue heron nesting site is also believed to exist along this stretch of the river. In 1991, several great blue herons were consistently observed arriving and departing from this area, as well as perching in the treetops. Each of these observed bird species is considered relatively common in this area.

Other species of wildlife known to occur in this section of riparian habitat are the blacktail deer (*Odocoileus hemonius columbianus*), beaver (*Castor canadensis*), and coyote (*Canis latrans*). A common garter snake (*Thamnophis ordinoides*) as well as crayfish (*Astacidea*) shells were also observed within this habitat area.

3.6.7.1 Effects and Mitigation of Alternative A-1 on Terrestrial Habitat and Wildlife: Partition the property into 20-acre parcels and sell as rural residential/agricultural tracts

Effects: Under Alternative A-1, pasturelands would be parceled into 20-acre tracts and sold to individual landowners for rural residential development and small-scale agricultural activities. Portions of the resulting 20-acre parcels are expected to remain as pastureland or small agricultural fields. As such, minor effects to the existing terrestrial environment are expected to occur, as overall land use is not expected to significantly change. Under this development scenario, opportunities to restore the historical mixed forest along this segment of the East Fork Lewis River valley would be reduced or lost.

Mitigation: No mitigation is proposed for effects or loss of potential restoration to the mixed forest environment under Alternative A-1.

3.6.7.2 Effects and Mitigation of Alternative A-2 on Terrestrial Habitat and Wildlife: Mine with no ITP

Effects: Sight and noise berms have been designed to avoid affecting two small wetlands next to J.A. Moore Road. Of the 8 acres of mixed forest located throughout the project area, none would be lost to mining. Of the 20 acres of disturbed mixed forest southwest of Bennett Road, 2 acres are estimated to be lost due to excavation.

Mitigation: Two acres of mixed woodland would be reclaimed as emergent wetlands further creating habitat diversity and leaving about 18 acres of mixed woodlands southwest of Bennett Road. Moreover, mixed woodlands are found throughout the area and, in the long-term, mixed woodlands would be naturally established between the created wetlands and ponds.

3.6.7.3 Effects and Mitigation of Alternative B on Terrestrial Habitat and Wildlife: Preferred Alternative

Effects: Under Alternative B, existing mixed woodland habitat would not be affected by the proposed mining activities. . There would be no mining on the 20 acres southwest of Bennett Road. Upon reclamation and restoration of the site under the HCP, Storedahl would substantially increase the amount of available mixed woodland habitat that is available on-site by replanting all available riparian and upland areas as per Figure 3-25. Mitigation: No mitigation is proposed for mixed forestland effects under Alternative B as no adverse effect to the existing stands is expected to occur.

3.6.7.4 Effects and Mitigation of Alternative C on Terrestrial Habitat and Wildlife: July 2000 HCP

Impacts and mitigation measures for Alternative C would be similar to those described under Alternative B in Section 3.6.7.3, except that the area southwest of Bennett Road would be mined and reclaimed as emergent wetland, as shown on Figure 3-26.

3.6.8 Wetlands-- Affected Environment/Baseline Conditions

Three small areas of isolated jurisdictional wetland (each less than 0.5 acre), one intermittent and one ephemeral stream were found within mixed forest, disturbed mixed forest, and cultivated pasture/planted crop community types. These wetlands are situated in slight depressions, which appeared to be relict channels of the East Fork Lewis River. The wetland in the mixed forest has an overstory dominated by Oregon ash (*Fraxinus latifolia*), cottonwood, and red alder, with a dense understory of trailing blackberry (*Rubus ursinus*), snowberry and red-osier dogwood (*Cornus sericea*). The disturbed mixed forest wetland is an isolated shrub-scrub wetland located adjacent and parallel to J.A. Moore Road. It has been altered and disturbed by an old driveway that crosses it. Dominant vegetation includes Oregon white oak (*Quercus garryana*), hazelnut, red-osier dogwood, vine maple and a variety of herbaceous species. The wetland in the cultivated field was dominated by herbaceous species, including western marsh cudweed (*Gnaphalium palustre*) and water pepper (*Polygonum hydropiperoides*), but has been planted to feed corn for the last few growing seasons.

Wetlands also occur along shorelines of the excavated ponds, although some of the shoreline is steep banked and dominated by dry-site species, such as Scots broom. Wetland areas along the shoreline include species such as cattail (*Typha latifolia*), soft rush (*Juncus effusus*), small-fruited bulrush (*Scirpus microcarpus*), and several species of sedges (*Carex spp.*). Dense patches of Hooker willow (*Salix hookeriana*) and Himalayan blackberry also occur along some shorelines.

3.6.8.1 Effects and Mitigation of Alternative A-1 on Wetlands: Partition the property into 20-acre parcels and sell as rural residential/agricultural tracts

Effects: Under Alternative A-1, the property would be partitioned and sold, as is, in 20-acre parcels. It is expected that the existing wetlands on the property would either be maintained as they are under existing agricultural practices or would be avoided or filled under current regulations by the future landowners during private development of their property.

Mitigation: No mitigation is proposed for protection of wetlands under Alternative A-1.

3.6.8.2 Effects and Mitigation of Alternative A-2 on Wetlands: Mine with no ITP

Effects: Under Alternative A-2, minor wetland effects are expected to occur, resulting in approximately 0.25 acres of wetland loss.

Mitigation: Reclamation of the proposed mining areas into open water habitat under Alternative A-2 would result in the creation of wetlands along the banks of the proposed mining ponds. Approximately 25 acres of high quality wetlands would be created. These would range from open water to emergent to scrub-shrub providing a diversity of vegetative structure offering wide opportunities for shelter, foraging, and nesting, and would replace the loss of 0.25 acres of low quality agricultural wetlands, a ratio of 100:1.

3.6.8.3 Effects and Mitigation of Alternative B on Wetlands: Preferred Alternative

Effects: As with Alternative A-2, the design for the mining footprint, and locations of the sight and sound attenuation berms avoid affecting the wetlands along J.A. Moore Road. Approximate 0.25 acres of agriculturally affected, low quality wetlands in the irrigated fields between the existing ponds and J.A. Moore Road would be excavated under Alternative B.

Mitigation: Restoration of the proposed mine site under Alternative B would result in approximately 59 acres of emergent, scrub-shrub and forested wetlands and riparian habitat being created along the margins of the existing ponds, the proposed mine ponds, within the existing processing area, and along the banks of Dean Creek. Similar to Alternative A-2, these would be high quality wetlands providing a diversity of vegetative structure offering wide opportunities for shelter, foraging, nesting and so on, and would replace the loss of 0.25 acres of low quality agricultural wetlands at a ratio of 212:1.

3.6.8.4 Effects and Mitigation of Alternative C on Wetlands: July 2000 HCP

Effects: As with Alternatives A-2 and B, the design for the sight and noise attenuation berms along J.A. Moore Road avoid affecting two small wetlands. The total area of wetlands that would be adversely affected under this alternative would be approximately 0.25 acres of low quality pasture wetlands, also similar to the other mining alternatives.

Mitigation: Similar to Alternative A-2, restoration of the mine site under this alternative would result in the creation of approximately 30 acres of emergent wetland and forested riparian areas along the margins of future ponds.

3.6.9 Dean Creek Riparian Area—Affected Environment/Baseline Conditions

There are two types of riparian communities in and adjacent to the project site. A very narrow riparian band was identified along intermittent Dean Creek, which forms the northwest border of the site. A much larger riparian zone is associated with the East Fork Lewis River, along the southern and western property boundaries.

Grazing and other agricultural activities have disturbed the riparian zone along both sides of Dean Creek. Just downstream of J.A. Moore Road, the riparian community is dominated by dense shrubs, including Himalayan blackberry, willow and Scot's broom. Grazing effects are especially evident in the reach north of Pond 5, downstream of where it bends west from the straight reach south of J. A. Moore Road. The overstory contains scattered Oregon ash, red alder and Pacific willow (*Salix lasiandra*). The shrub and herb layers are poorly developed. Grazing in this area has contributed to bank slumping, excessive erosion, and large unvegetated areas beside Dean Creek. Downstream of the heavily grazed reach of Dean Creek the riparian zone along Dean Creek is in better condition. There is a dense, well-developed shrub layer and a moderately developed herb layer dominated by reed canarygrass (*Phalaris arundinacea*).

3.6.9.1 Effects and Mitigation of Alternative A-1 on Dean Creek Riparian Area: Partition the property into 20-acre parcels and sell as rural residential/agricultural tracts

No effects or enhancement efforts are anticipated under Alternative A-1. As such, no mitigation is proposed under this Alternative.

3.6.9.2 Effects and Mitigation of Alternative A-2 on Dean Creek Riparian Area: Mine with no ITP

Effects: Mining activity would take place no closer to Dean Creek than 50 feet. A setback berm would be constructed in the outer 10 feet of this 50-foot strip.. This setback berm would eliminate or reduce the likelihood of Dean Creek avulsing into the Daybreak ponds.

Mitigation: Under this Alternative, riparian areas associated with Dean Creek on the subject property would be improved. Existing native shrubs and trees between the setback levee and the creek would be retained; invasive species would be removed and additional native valley bottom forest species or streambank vegetation would be planted to augment the wildlife habitat functions within this riparian area and to stabilize the protective berm.

3.6.9.3 Effects and Mitigation of Alternative B on Dean Creek Riparian Area: Preferred Alternative

Effects: Under Alternative B, riparian areas associated with Dean Creek would be improved by the proposed project. In particular, a floodplain terrace corridor would be restored and enhanced along the east bank of Dean Creek adjacent to the proposed mine site. Mining activity would take place no closer to Dean Creek than 75 feet. From this setback, a 125-foot swath would be backfilled and reclaimed with a gentle upslope creating a floodplain terrace planted with native riparian vegetation. This terrace would allow the north-south reach of Dean Creek to meander laterally during high flows but not allow the stream to enter the reclaimed mining ponds.–

Mitigation: Under alternative B, riparian forests plantings, bank stabilization using bioengineering, and placement of in-channel large woody debris would help enhance the habitat quality of Dean Creek by reducing temperatures and increasing channel complexity. Stabilized banks and increased vertical scour around obstructions would create deeper pools and, in conjunction with the flow augmentation proposed in the water management plan, help maintain surface flows through the summer and increase the likelihood of creating refugia for fishes in the summer when flows are low. Reconfiguring the Pond 5 outlet to prevent inflows from Dean Creek, and implementation of the water management plan would increase instream flows in Dean Creek during late summer low flow periods, increasing the amount of available habitat and benefiting water quality. Please refer back to Section 3.6.1.4 for additional discussion.

The riparian zone along Dean Creek would also be enhanced considerably relative to present conditions. The total area of riparian and forested wetland habitat that would meet jurisdictional criteria in the future cannot be quantified. However, the restored riparian and cottonwood-alder forest areas would be a substantial contribution to the amount and quality of wetland habitat at the project site and near the lower East Fork Lewis River, as defined by the USFWS (Cowardin et al. 1979).

3.6.9.4 Effects and Mitigation of Alternative C on Dean Creek Riparian Area: July 2000 HCP

Effects: The effects of this alternative on Dean Creek would be similar to those in Alternative A-2, except that the 7-10 residential parcels would not be created and associated dwellings constructed.

Mitigation: Mitigation for the effects to Dean Creek would be quite similar to those in Alternative A-2.

3.6.10 Effects and Mitigation Under All Alternatives to Riparian Areas

Under Alternatives A-1, A-2, B and C, no direct effects to the East Fork Lewis River riparian habitat is expected to occur as a result of the proposed mining. As such, no mitigation measures are proposed. Instead, voluntary enhancement efforts in the lower East Fork Lewis River by non-profit or public entities would be physically and/or financially supported by Storedahl under Alternative B, as described in Section 3.6.1.4 of this document.

3.6.11 Adjacent Areas—Affected Environment/Baseline Conditions

The habitat value of the area surrounding the subject property on the north side of the East Fork Lewis River has been reduced by human disturbance related to rural residential development and agricultural practices. The landform is generally the same along the river up and downstream. Vegetation along the level terrace adjacent to the East Fork Lewis River exhibits features consistent with the project site. North and northeast of the site is a hillside. Vegetation along the hill to the north and northeast consists primarily of an evergreen and deciduous forest, with rural residential development along the crest.

3.6.11.1 Effects and Mitigation Under All Alternatives to Adjacent Areas

No direct effect to adjacent habitat areas is expected to occur under any of the four Alternatives discussed. Under Alternative B, Storedahl would physically and/or financially supplement efforts to enhance the East Fork Lewis River watershed as discussed in Section 3.6.1.1.7.

3.6.12 Terrestrial Species—Affected Environment/Baseline Conditions

Only one terrestrial species of concern has been determined to have potential populations within the project site: the Oregon spotted frog (*Rana pretiosa*). Oregon spotted frogs are amphibians, laying their eggs in flooded areas or wetlands. Due to population declines, the Oregon spotted frog is a candidate for listing as a federal endangered species and is listed as a state endangered species (McAllister and Leonard 1997). The reason for their decline is unknown, but degradation of wetlands and introduction of the bullfrog (*R. catesbeiana*) have most likely contributed to the reduction in their numbers (Hayes and Jennings 1986). Oregon spotted frogs have been found at only four sites in Washington (McAllister 1999). The documented sightings closest to the project site are in Thurston and Klickitat counties. The frog is more abundant in Oregon, but populations in Oregon tend to occupy higher elevation-sites, which in Washington would be occupied by Cascade frogs (*R. cascadae*) (McAllister 1999).

The Oregon spotted frog is highly aquatic, nearly always found in marshes or on the edges of lakes, ponds, and slow streams with non-woody wetland plant communities including sedges, rushes, and grasses (Corkran and Thoms 1996). Adults usually feed on insects captured from the water or within 2 feet of the shoreline. Wetlands in Washington that support spotted frogs are usually shallow emergent wetlands associated with prairie or sparse grasslands that become inundated during high water (McAllister 1999). Adults lay eggs in these inundated areas, usually in February or March (Leonard et al. 1993). Adult spotted frogs are active from February through October and then hibernate in muddy pond bottoms near breeding sites for the rest of the year.

An amphibian survey in Clark County in February 1998 indicated that frog egg masses believed to potentially be those of Oregon Spotted frogs were located at several sites in the county, including one at the project site (Corkran 1999a). During this survey, five eggs were collected from the Storedahl site for rearing and identification. However, a positive species confirmation could not be made. In a later survey for tadpoles and adults, county and WDFW staff did not observe any Oregon spotted frogs in Clark County (McAllister 1999). A follow-up survey collected possible Oregon spotted frog eggs from one site on private land approximately 2 miles south of the project site. Using DNA testing (Corkran 2000), the eggs were identified as red legged frogs (*Rana aurora aurora*), which is a common species in western Washington and Oregon.

At present, Oregon spotted frogs have not been observed at the project site or elsewhere in Clark County. The project site contains habitat that could potentially support Oregon spotted frogs, although the rarity of the species in the state and the presence of highly predatory bullfrogs and largemouth bass in the existing ponds make it doubtful that a self-sustaining population of Oregon spotted frogs exists at this site.

No other threatened or endangered amphibian or terrestrial species that could potentially exist in the project site are likely to be effected by the proposed mining and reclamation.

3.6.12.1 Effects and Mitigation Under all Alternatives to Terrestrial Species

Alternative A-1 could have adverse effects on Oregon spotted frogs, should they recolonize the site, during construction of residences or outbuildings or during field cultivation or crop harvest. Vehicular mortality could also occur as future residents access their home sites or the distal portions of their tracts with vehicles or farm equipment. However, most of those activities would be expected to occur away from the habitat provided by the existing ponds. Alternative A-1 does not include any measures to survey or confirm the presence of Oregon spotted frogs on the subject property or measures to protect them.

Activities under all thee mining alternatives could adversely affect Oregon spotted frogs by potentially resulting in take if the species should recolonize the site. The potential for take would result from vehicular mortality, excavation activities, filling and reconfiguration of the existing or future ponds, and predation by non-native species.

Under Alternatives A-2, B and C, mitigation measures would be implemented to protect the species if the frog is determined to be present within the project site. In particular, surveys would be conducted to determine whether the species had recolonized the site, and if so, exclusion fences to restrict breeding frogs from entering proposed mine sites during mining activities would be installed. Mining and reclamation windows would be observed in areas where known breeding populations occur to avoid negative effects to this species during the breeding season. Predator habitat would be reduced, target harvests of predators would be conducted and signs would be installed warning the public of the dangers of releasing non-native fish species into the ponds. With the implementation of these measures, the potential for predatory take of Oregon spotted frogs is low, although the numbers of individuals are not known.

3.6.13 Summary of Effects of Alternative Actions on Terrestrial Habitat and Wildlife

Alternative A-1 would provide the least benefit to terrestrial habitat and wildlife as it is the most likely of all four alternatives to maintain a monoculture similar to what presently exists on a majority of the site. In the three mining alternatives, varying degrees of restoration to open space and open water habitat would increase the available habitat for a myriad of woodland creatures and waterfowl. A human presence on the site resulting from the partitioning of the site post reclamation and development of 7 to 10 rural residential tracts would provide some disturbance to the wildlife species otherwise attracted to the reclaimed ponds and surrounding forested area. Alternatives B and C would further enhance the terrestrial environment by insuring that the area would remain as green space indefinitely, adding to wildlife accessibility along the East Fork Lewis River greenbelt corridor.

3.6.14 Analysis of the Cumulative Effects of the Alternative Actions on Terrestrial Habitat and Wildlife

The cumulative effects on terrestrial habitat and wildlife of the three mining alternatives would vary slightly among them. Those of the non-mining alternative would be substantially different.

Mining and reclamation of the expansion area along with reclamation of the existing ponds and processing area would result in a restoration of the site to a valley bottom forest among a variety of ponds and wetlands, replacing what is presently open pasture or cultivated fields. Alternative B would include a conservation easement limiting the use of the property to habitat enhancement in perpetuity. Under Alternatives B and C, the site would be gifted to one or more not-for-profit organizations or public entities for inclusion in the greenbelt under acquisition by Clark County to preserve the area for wildlife habitat and open space. Adding the 300 acre site to the greenbelt would facilitate the continuity of habitat provided and maintained, and planned for expansion through the East Fork Lewis River valley. Improved habitat provided by the restored areas would begin in areas not planned for mining upon issuance of the ITP and create a varied age valley bottom forest at the end of mining. On the contrary, Alternative A-2 would result in reclamation to a valley bottom forest with associated wetlands around the existing and new mine pond margins. However, the site would also be retained by private ownership and developed for 7 to 10 rural residential sites which would reduce the habitat value compared to the two action alternatives, and the property would not be gifted to the organizations acquiring the greenbelt for habitat preservation, essentially eliminating the possibility of the site exclusively providing habitat functions.

Development of the site into rural residential/agricultural tracts and land uses would further reduce the already limited, natural habitat values presently offered. The development scheme would also create a substantial barrier in the greenbelt and the valley bottom habitat system intended and planned for by the county and its partners.

3.7 Built Environment

This section presents a background discussion and a baseline discussion of the nature and characteristics of the environment built and maintained by humans. Following the baseline discussion are analyses of the effects of the four alternatives on existing and planned development relative to the physical and socioeconomic environment. The physical environment is discussed in terms of existing land uses, planned land uses, and traffic and transportation. The socioeconomic environment is discussed in terms of utilities and services, noise, visual resources, archeological resources, recreation, energy and natural resources, and water, stormwater, sewer, solid waste and other utilities services. Following the analysis are proposed mitigation measures for each alternative.

3.7.1 Background

Floodplain function and habitats in many Pacific Northwest rivers, including the East Fork Lewis River, have been dramatically altered by human activity. Human use of the floodplain has generally taken political and social priority over the benefits of channel migration: thus, natural river migrations are generally prevented (Golder and Associates 1998). In 1854, nearly the entire valley bottom between river mile 6 and river mile 10 was described as wetlands, and the upstream portion of the reach included extensive channel braids (Collins 1997). By 1937, the mainstem was a single-thread channel, and all that remained of the former channel braids was a system of floodplain sloughs (Collins 1997). Conversion of the channel from braided to single-thread morphology has substantially reduced the complexity of habitat and largely eliminated side-channel and backwater habitats (Norman et al. 1998), while providing agricultural and development property.

Gravel Mining

Commercial floodplain gravel mining began in about 1940 in most Washington rivers (Collins 1997). Mines were developed in abandoned channels of the formerly braided system along both sides of the East Fork Lewis River. Gravel was also taken from within the active river channel during summer low flows. As of 1998, gravel mine ponds covered approximately 200 acres of the East Fork Lewis River valley bottom between river miles 6 and 10 (Norman et al. 1998).

Since 1935, channel migration near river mile 8 has largely been limited to a several-hundred-foot-wide bandwidth. An exception is one large meander bend just south of the project site that abandoned its former course and shifted over 1,000 feet to the south between 1935 and 1963 (WEST Consultants 1996). In November 1996, the river avulsed through six gravel ponds at the Ridgefield site, southwest of the project site, forming a new channel with a bed elevation several feet lower than the old channel (WEST Consultants 1996). Immediately before the 1996 avulsion, the secondary channel abandoned between 1935 and 1963 was noted to be flowing full (WEST Consultants 1996). More than 2 million cubic yards of material would be required to refill these ponds; it is estimated that refilling would take decades. Until then, the likelihood of the channel migrating from the Ridgefield site toward the Daybreak site remains low.

Agriculture

By 1951, most of the valley bottom had been cleared, drained, and leveled for farming. Conversion of the floodplain to agricultural land has affected aquatic habitat in a variety of ways, including disconnection of side-channel habitat, destabilization of stream banks by livestock, runoff of fertilizer, pesticides, and fecal coliform bacteria into the river, and preclusion of riparian succession.

Rural Residential Development

Expanding populations in nearby cities such as Portland and Vancouver have caused farmland and wetlands to be converted into low-density residential areas. The primary effects of residential development on river ecosystems are as follows:

Water quality degradation through sewage discharge and septic tank seepage, spills of pollutants, runoff over fertilized surfaces;.

Accelerated storm water runoff due to increased 'hard surfaces';

Increased fishing pressure as the population expands;

Filling of wetlands and drainage channels for development; and

Removal of riparian vegetation, which may increase summer water temperatures.

Pollutants associated with residential development that would influence water quality include petrochemicals and related byproducts, herbicides and pesticides, other organic compounds, and nutrients.

Development of low-density residential areas has increased dramatically in recent years. Between 1960 and 1990, the population of Clark County increased by 154 percent (1995a). More recent information demonstrates the continuing population growth of Clark County with 345,238 residents in the 2000 Census estimate, or a 45 percent increase from 1990, the highest population growth rate of any Washington County. (http://www.census.gov/Press-Release/www/2001/tables/wa_tab_6.PDF)

3.7.2 Physical Environment

The physical environment includes the land uses noted above, that is, agricultural 'hobby farms', rural residential, and the existing gravel processing operation. These are located on terraces of the broad geomorphic floodplain of the East Fork Lewis River. Above the valley floor, to the north and south, is additional rural residential development.

3.7.2.1 Existing Land Uses-- Affected Environment/Baseline Conditions

Project Site

The project site consists of 300 contiguous acres adjacent to the East Fork Lewis River and transected by J. A. Moore Road/NE 61st Avenue/Bennett Road (Figure 1-1). A 0.8-acre parcel at the corner of Bennett Road and NE 61st Avenue is used for rural residential purposes and is surrounded by the project site, but is not a part of this proposed project. Mining and related activities have been conducted on approximately 80 acres, resulting in five ponds of varying sizes and stages of use and reclamation, areas used for finished material stockpiles, and the site access road. Improvements and equipment on site include raw aggregate processing equipment, a small office/scale house, a maintenance building, equipment and fuel storage, truck and employee parking,. Also on-site is a raw material electrical conveyor system approximately 900 feet long.

The processing equipment includes a control facility and several conveyor systems that move the raw materials through the processing sequence. The control facility, conveyors, and processing equipment are mounted on trailers for portability. Front-end loaders and off-road trucks transport the processed rock to stockpiles of various finished material grades and sizes where it is stored before delivery to customer job sites. Supporting equipment includes a small float supporting pumps in Pond 2, which withdraws water for the classifier and a small building that stores chemical additives which are dosed into Pond 1 as part of the processing water treatment activities. Next to the metal building is a 5,000 gallon double walled tank for other water treatment additives.

The balance of the project site consists of cultivated fields used to pasture livestock and grow corn and hay, and three residential buildings owned by Storedahl. A wood-frame house and a mobile home are located immediately south of J. A. Moore Road and a second “stick-built” residence is on the north side. Individual on-site water and septic systems serve these residences.

Application for shoreline permits from Clark County are pending for several components of the proposal. These include several noise attenuation berms or structures, extension of the conveyor system that would transport raw materials from the mining ponds back to the processing area for crushing, sorting, cleaning and stockpiling. Other aspects of the proposal included in the shoreline permit applications include the existing stockpile areas, the existing scale house and scale, the existing shop, the existing process water intake pump and piping in existing Pond 2, and the existing process water treatment additive storage tanks and dispersal apparatus. These items are part of the long-existing processing area. Other equipment in the processing area but outside of shoreline jurisdiction include the crushing, washing and sorting equipment.

Adjacent Properties

Land-use patterns near the project site cover a range of typical rural activities. Scattered rural residential development exists in the lowland area north of the site. A mining/grading operation independent of Storedahl is ongoing on the hillside north of J. A. Moore Road, on the east side of Dean Creek. The mine operator is removing fine sand and silt for sale as fill from what appears to be the lower member of the Troutdale formation. (Verification would require permission or trespass; at this writing, there is no mine reclamation plan on file with the Washington Department of Natural Resources. In the past year, several hundred thousand cubic yards of material appear to have been mined at this location. The operator has not filed an "Annual Reclamation Report" with DNR describing the area of disturbance during this time period, thus there is no public record of mining activity (Personal Communication with Chris Johnson, DNR, by Skip Urling, May 9, 2002).

Development on the ridge along 284th Street north of the project site is limited to low-density (minimum 5-acre tracts), rural residential land use, with a similar pattern further north along 289th Street. The lowland east of the project site and north of 269th Street is also generally developed as 5-acre rural residential uses, with some older parcels smaller than 5 acres and others still undeveloped. Scattered rural residential land use and a county road shop lie south of 269th Street.

Immediately south of Storedahl Pit Road (Figure 3-6) is county-owned property containing an inactive sand and gravel mine. The mine is in an alder-cottonwood forest that extends south and west to the East Fork Lewis River channel. This large tract of county-owned undeveloped open space is potentially part of the greenbelt being acquired by Clark County and other conservation organizations along the East Fork Lewis River. Large parcels where varying agricultural uses are interspersed with rural residential uses dominate the high terrace south of the East Fork Lewis River.

West and across the river from the project site are ponds resulting from previous mining, which are owned by Pacific Rock Environmental Enhancement Group, Inc. On the west, the adjacent property contains a mixed hardwood forest along the river's edge and livestock pasture and a dairy farm on the northwestern upland. Further north and west is more pastureland.

3.7.2.2 Effects and Mitigation of Alternative A-1 to Existing Land Use: Partition the property into 20-acre parcels and sell as rural residential/agricultural tracts

<u>Effects</u>: Implementation of this alternative action would result in the development of the project site into approximately 14 20-acre tracts developed as ultra-low density rural residential uses with limited agricultural activities. Parcels most distant from the processing area would be developed first, that is, while imported materials continue to be processed at the site. When the raw material imported for processing is depleted (projected at 10 to 15 years), then the processing area would be reclaimed and the balance

of the property would be developed. The tract areas and dimensions would meet the standards of the Clark County zoning code, as would the subsequent use. Such development would be consistent with the Clark County comprehensive plan and shoreline master program guidelines. Impacts on land uses would be limited because of the area's existing agricultural and low-density rural residential uses. The open space currently provided by single ownership and the expanse of pastureland of the project site would be diminished as new parcels are developed.

Pursuant to the Clark County Critical Areas Ordinance, construction would not be allowed within 200 feet of Dean Creek or the East Fork Lewis River, without additional permits and County SEPA review. This type of rural/agricultural activity will result in more intensive cultivation of various tracts to enhance their productivity or aesthetic appeal through increased use, e.g., raising of row crops, pastures and ornamental plants, and application of pesticides, herbicides and fertilizers, plus an increase in livestock manure. It is assumed that future property owners would follow the protocols and best management practices in the application of the various chemicals and livestock density. Such activities are common and, because they would be taking place well away from the East Fork Lewis River, would not be likely to create a situation that would cause direct harm to any of the listed aquatic species. A NPDES Construction Stormwater General Permit for stormwater discharge from construction activity, as administered by Ecology, is not required unless the construction activity will disturb five or more acres. Even if an NPDES permit were required for such activity, it would not require ESA Section 7 consultation, because such permits are issued by Ecology rather than by a federal agency. Further, CWA permits have not historically been required for typical agricultural use of herbicides and pesticides. Recent legal developments (case law) may now create the environment for closer scrutiny of agricultural use of pesticides and herbicides but at present CWA permits are not required for application of herbicides and pesticides. Further, demonstrating that herbicides or pesticides have resulted in "take" due to showing proximate cause of death or injury to listed salmonid fish is difficult, even if such application was the cause of "take".

<u>Mitigation</u>: Mitigation under Alternative A-1 would include continued watering of the existing processing area for dust control, maintaining separation of the processing plant from noise-receiving properties, and keeping noise levels below regulatory thresholds. Hoods would be installed on lighting fixtures to reduce the glare on neighboring properties. The tracts developed under this alternative action would be consistent with the Clark County comprehensive plan land-use designation and policies, zoning code standards, and shoreline master program guidelines. No conflicts with these regulations would occur, and no mitigation related to development would be necessary.

3.7.2.3 Effects and Mitigation of Alternative A-2 on Existing Land Use: Mine with no ITP

<u>Effects</u>: Expanded mining under Alternative A-2 would be consistent with past and present land uses of the project site. Almost a quarter of the project site is already mined or used for mineral resource processing. Geologic review indicates that a substantial volume of high-quality gravel remains and is easily accessible for extraction. A portion of the site is zoned for surface mining and that portion of the site where mining is proposed was previously zoned for surface mining.

Proposed mining and reclamation of the site for upland, riparian, and aquatic habitat, would significantly change the landform and preclude its continued use as pasture and hayfields. The agricultural productivity of the site has been nominal, and the geology and porous nature of the surface soils limit their moisture-holding capacity. Irrigation is required for any economic crop production, even for livestock pasturing or hay. Based on information in the current comprehensive plan, the county has 64,440 acres of agricultural land outside the urban growth boundaries of its seven cities. Converting the remaining 178 acres of the project site not presently mined and used for processing, or reserved for riparian habitat to mining on a temporary basis and reclaiming it to provide wildlife and aquatic habitat would reduce the amount of land devoted to agricultural uses in Clark County by about 0.25 percent. Ultimate conversion of the property, as discussed above, would upgrade the amenities of the property as open space and increase the amount of fish and wildlife habitat. It would likely also add to the value of the seven to ten potential building sites created by partitioning after reclamation and made available for sale as low-density rural residential parcels.

Potential off-site effects of surface mining on the Rural Estate development near the site include noise from the excavation and earth-moving equipment, dust, and visual changes.

<u>Mitigation</u>: A variety of measures would be implemented to mitigate the effects of mining under Alternative A-2 on adjacent land uses. Sound berms and noise attenuating structures would be constructed to absorb or deflect noise. Berms would also be constructed to screen the view of mining activities of the proposed excavation areas from adjacent parcels. Grass would be planted to stabilize the soils and improve the aesthetics of the taller berms. Trees and other shrubs would be planted on the screening berms to augment their noise-reduction and visual-screening functions.

Because raw materials would be mined primarily from below the water table, dust is more likely to result from moving the sand and gravel from the stockpiles to the processing facility or conveyor system and when sand and gravel is off loaded from the conveyor system than from the actual mining activity. To control fugitive dust emissions, the temporary raw material stockpiles and haul roads would be periodically watered and spray bars would be installed at the terminus of the conveyor. New lighting is not proposed for the excavation equipment or conveyor system, so additional sources of illumination would not have any effects related to light or glare. Existing lamp fixtures would be retrofitted with shields or visors to reduce the glare on neighboring properties.

3.7.2.4 Effects and Mitigation of Alternative B to Existing Land Use: Preferred Alternative

Effects: Impacts to the existing land use of the project site would be similar to those under Alternative A-2, except there would be a conservation easement placed on the property and there would be no partitioning and sale of parcels for low-density rural residential development after reclamation.

Mitigation: Mitigation beyond the reclamation plan in Alternative A2 and other operational considerations is proposed to compensate for the change in land use on the project site. These items would include the numerous conservation measures proposed in the final HCP aimed at the physical re-creation of the natural landform. Specifically, the conservation measures would include the early revegetation of non-mining areas as valley-bottom forest in the early phase of mining, backfilling and replanting the existing ponds to make them "avulsion ready," creation of shallow water and wetland habitat, in-channel habitat enhancement in Dean Creek, and the rehabilitation of the riparian management zone and creation of a floodplain terrace along Dean Creek. Following reclamation, a conservation easement on the property would insure its natural state in perpetuity.

The potential off-site effects of surface mining on the Rural Estate development near the site include noise from the excavation and earth-moving equipment, dust, and visual changes to the area. Among the various mitigation measures is a proposed mining sequence that has generally been reversed from that shown in the initial site plan application submitted to Clark County in 1998. After the initial mining and reclamation activities along Dean Creek and at the entrance to the site, mining would move to the eastern part of the site and work west, which would create a large buffer between the greatest number of residences and the mining operation in a shorter period of time than originally proposed. The mining sequence would also allow the vegetative screening around the largest excavations at the site to develop which would reduce visual and noise effects, while accelerating habitat enhancement. Sound berms or other noise attenuation structures would be constructed in appropriate locations to absorb or deflect noise. In other areas, berms would be constructed to screen the views of the mining activities of excavation areas from adjacent parcels.

Grass would be planted to stabilize the soils and improve the aesthetics of the taller berms. Trees and other shrubs would be planted on the screening berms to augment visual screening. To control fugitive dust emissions, the temporary raw material stockpiles and haul roads would be watered as necessary and spray bars would be installed on the conveyor system.

New lighting is not proposed for the excavation equipment or conveyor system, so additional sources of illumination would not have any effects related to light or glare. Lamp fixtures would be retrofitted with shields or visors to reduce glare on neighboring properties.

3.7.2.5 Effects and Mitigation Proposed for Alternative C to Existing Land Use: July 2000 HCP

Environmental effects and proposed measures to mitigate the effects of mine expansion associated with Alternative C on existing on-site and adjacent land uses would be similar to those described in Alternative B. Exceptions would include the absence of a conservation easement, construction of the berm in the riparian management zone along Dean Creek and the absence of backfilling of the existing ponds to make them avulsion ready.

3.7.2.6 Planned Uses -- Affected Environment/Baseline Conditions

Project Site

The *Clark County 20 Year Growth Management Plan,* developed in compliance with the Growth Management Act designates the project site as Agricultural Land. Approximately 58 acres (40 acres east of 61st Avenue and 18 acres west of J. A. Moore Road) of the 178-acre portion of the project site proposed for mining expansion, are designated as Mineral Resource Lands. The entire project site has been zoned Agriculture-20, with the Surface Mining Combining District overlay applied to the 58 acres of Mineral Resource Lands. The minimum parcel size in this zoning district is 20 acres, and uses permitted outright are those typically associated with agricultural activities including farming, livestock production, silviculture, pole yards, small saw mills, and residences, among others. Mining is allowed in AG-20 when a “mining overlay” is included with the zone. The remainder of the project site had been designated with the mining district overlay until the county adopted the comprehensive plan policy prohibiting mining in the 100-year floodplain. (As explained previously, the boundary of the 100-year floodplain was revised by FEMA in July, 2000.) The county’s growth management plan states that agricultural lands are those thought to have long-term commercial significance for agricultural and associated resource production. The plan also states that mineral resource extraction is one of the primary uses of land in the agricultural areas (Policy 4.4.4, CCGMP). The *Clark County Shoreline Management Master Program* designates the portions of the project site within 200 feet of the East Fork Lewis River, or its defined floodway, and associated 100-year floodplain as a Rural Shoreline Environment. The current regulatory floodplain boundary is illustrated on Figure 3-5.

The Clark County Shoreline Master Program was adopted in1974 and designated that area of the project site within shoreline jurisdiction as a Rural Shoreline. Shoreline areas are those lands extending 200 feet landward from the ordinary high water mark of the

East Fork Lewis River, contiguous floodplain areas, and lands within 200 feet from the edge of the floodway. The master program states that the rural designation is designed to protect and support agricultural activities and intensive recreational development. The explicit objective is to alleviate pressures of urban expansion on prime farming land, function as a buffer between urban areas, maintain open space, and allow recreational uses compatible with agricultural activity. The Rural Shoreline Environment authorizes mining in the area of shoreline jurisdiction, subject to obtaining a shoreline conditional use permit. It is important to note that no mining is proposed within shoreline jurisdiction, although mineral resource processing in portions of the shoreline area is proposed to continue. The shoreline management program does not address processing and storage of sand and gravel.

As stated in the elsewhere in this document, the Clark County subdivision code has a threshold of 20 acres, i.e., partitions of property resulting in parcels larger than 20 acres are not regulated by the county and do not require any county action. This regulatory environment is consistent with the GMA. Clark County has adopted a number of ordinances designed to manage development in critical areas as defined in the GMA. Critical areas include: a) wetlands; b) areas with a critical recharging effect on aquifers used for potable water; c) fish and wildlife habitat conservation areas; d) frequently flooded areas; and e) geologically hazardous areas. However, because there is no action required by the county or any other agency for the partitioning the property, County review would apply to a specific land use development proposal. To the Services knowledge, subsequent development on the partitioned tracts would not necessarily require a federal permit; therefore, the Services would not necessarily undertake a Section 7 consultation, even on subsequent development proposals. In the absence of a federal permit requiring Section 7 consultation, ESA would constrain future residential development only if such development could be shown to cause "take" of listed species. The cumulative impacts of residential development can clearly have an adverse effect on listed fishes.

Adjacent Areas

The comprehensive plan land-use designation for the adjacent properties to the north and east is Rural Estate 5. To the south, the property is designated Agriculture-20 and Rural Estate 5. Properties to the west and northwest are designated Agriculture-20. The zoning districts on the adjacent properties are consistent with comprehensive plan designations. Adjacent properties within the shoreline jurisdiction are also classified as Rural Shoreline Environments.

The Rural Estate 5 designation is intended to provide lands for rural residential living, and allows and encourages on-site, small-scale natural-resource activities. Such designated areas are also subject to normal and accepted farming and forestry practices, and by implication, other permitted natural resource based activities on adjacent lands.

3.7.2.7 Effects and Mitigation of Alternative A-1 on Planned Uses: Partition the property into 20-acre parcels and sell as rural residential/agricultural tracts

Effects: Development of the 14 20-acre tracts and continued processing under Alternative A-1 would be consistent with current comprehensive plan designations and zoning regulations. Certain elements of the existing processing facility are within shorelines jurisdiction and shorelines permit applications for the continued processing are pending.

Mitigation: No mitigation is proposed for Alternative A-1. Any subsequent development within the 100-year floodplain would be required to meet appropriate standards of elevating the first habitable floor above base flood elevation, but no additional mitigation would be required.

3.7.2.8 Effects and Mitigation of Alternative A-2 on Planned Uses: Mine with no ITP

Effects: Mining under Alternative A-2 should have no significant adverse effect on planned land-use patterns in the vicinity. Much of the land in the vicinity of the project site is planned for agricultural uses similar to those on the project site. Natural and agricultural resource based land uses are encouraged and would be permitted activities in this agricultural land use designation and mining of the project site would not preclude or retard those activities from occurring on the neighboring tracts similarly designated. The only other planned use in the vicinity is Rural Estate, which is intended to allow low-density rural residences and small farms next to land used for resource-based activities and to support similar but smaller activities than larger adjacent parcels (Clark County 20 Year Comprehensive Growth Management Plan, December 1997, p. 2-14.) Here too, mineral extraction activities on the project site may retard the development of rural residences, but would not act to preclude them or smaller scale natural and agricultural resource related activities on these properties. The post reclamation partitioning and development of low-density rural residential uses would be compatible and consistent with the existing adjacent land uses.

Shoreline areas adjacent to the area that could be affected by the mining activity would be limited to that portion of the 100-year floodplain that extends onto the subject property, although mining would not occur within the regulatory floodplain. Ultimately, these areas would be improved by limited habitat enhancement during the initial and sequential reclamation of the site and after mining is complete. Surface and groundwater quality would be maintained to current levels to protect aquatic habitat of the East Fork Lewis River and the limited amount of habitat currently provided by Dean Creek. The quantity of water reaching the East Fork Lewis River would be comparable to current amounts.

Because the project site is privately owned, public access to the shoreline would not be affected by the proposed mining activity. Mining via Alternative A-2 would not affect the potential uses of the neighboring properties within the shoreline jurisdiction. Uses permitted in the Agricultural-20 and Rural Estate 5 zoning districts and allowed within the rural shoreline designation are generally limited to low-intensity residential, associated agricultural and resource based activities, with the limitations established more through the zoning regulations than those of the shoreline master program. However, as mining is listed as a shoreline conditional use (Shoreline Master Program, Clark County Washington, August 1974 p. 67), additional review and scrutiny of such proposals effectively increases the regulatory review. The comprehensive plan land use pattern as implemented through the zoning map is designed to avoid land use conflicts. Because the comprehensive plan explicitly states that other resource based activities are permitted and encouraged in adjacent rural zoning districts, these types of uses would be consistent and compatible with the proposed mining and reclamation to fish and wildlife habitat.

<u>Mitigation</u>: A rezone application has been submitted to Clark County to extend the surface mining combining district overlay to that portion of the project site where the surface mine zoning overlay was removed, but which is now outside of the regulatory floodplain. Subsequent to the rezone application, Storedahl submitted an application to Clark County for site plan review. The area subject to the rezone application exhibits characteristics identical to that portion of the site where the overlay zone exists. Mining and reclamation following a DNR approved reclamation plan would allow continued land use in the vicinity consistent with what has been planned by the county. Mining and subsequent reclamation would leave the site in a state approximating that prior to colonization of the area, with fish and wildlife habitat improved over existing conditions. The mining plan has been designed to meet the county surface mine combining district zoning standards. No activities beyond those designed to reclaim the site or to temporarily reduce effects of noise, dust or aesthetics are proposed or considered necessary.

The proposed mining should have no significant adverse effect on the planned land-use patterns in the vicinity. Much of the area is planned for agricultural uses, similar to those on the project site. The only other planned use is Rural Estate, which is designed to be next to land used for resource-based activities and to support similar but smaller activities. Post reclamation partitioning and development for low-density rural residential uses would be compatible and consistent with current adjacent land uses.

3.7.2.9 Effects and Mitigation of Alternative B on Planned Uses: Preferred Alternative

<u>Effects</u>: Under Alternative B, effects are expected to mimic those discussed for Alternative A-2 in Section 3.7.2.8 above during the active mining and reclamation. However, the post reclamation conservation easement and gifting of the property to a non-profit organization would preclude additional low-density development on the property in perpetuity.

Mitigation: The rezone and site plan application discussed in Section 3.7.2.8 above would apply to Alternative B as well. The proposed mitigation measures identified in the final HCP would allow continued land use in the vicinity consistent with what has been approved by the county. Mining and subsequent reclamation and enhancement activities would leave the site with fish and wildlife habitat features, such as valley bottom forest, open water, emergent and forested wetlands, and enhanced riparian areas along Dean Creek where only managed pasture and crop land now exists. Ownership of the land would be transferred, in fee, to a nonprofit entity that could manage it in perpetuity as open space for wildlife habitat. Prior to land transfer, the land would be encumbered by a conservation easement limiting land uses to those consistent the conservation and management of fish and wildlife habitat. Upon transfer of ownership, a $1 million endowment would be established and funded to maintain the property. In addition, existing water rights associated with the property would be donated to the State Trust for enhancement of instream flow and public access would be generally restricted to pedestrian use on developed pathways

3.7.2.10 Effects and Mitigation of Alternative C on Planned Uses: July 2000 HCP

Effects: Effects associated with Alternative C would be similar to those discussed for Alternative A-2 except there would not be post reclamation partitioning and low-density rural residential development because the property would be gifted to a non-profit organization. In addition, no endowment would be passed to the non-profit organization for management of the property.

Mitigation: The rezone and site plan application discussed in Section 3.7.2.8 above would apply to Alternative C as well. Alternative C, like Alternative B, would provide for reclamation and enhancement of the site beyond the requirements of a DNR reclamation plan. Enhancement efforts associated with Alternative C, however, would not be as in depth as those discussed for Alternative B. In particular, Alternative C would not provide for a restrictive conservation easement, provide and endowment for future maintenance and management, donate water rights to the State Trust, or control public access to the site other than limiting vehicular and foot traffic from riparian areas.

3.7.2.11 Traffic and Transportation-- Affected Environment/Baseline Conditions

This section summarizes an evaluation of the existing traffic conditions near the project. The complete *Daybreak Mine Transportation Impact Study* prepared by DKS Associates (DKS July 1998) is attached as Appendix A.

Direct access to the mine site is available via Storedahl Pit Road, an improved asphalt private way off Bennett Road/61st Avenue. Both Interstate 5 and Interstate 205 provide regional access to the site. The following local roads serve the neighborhoods near the project site:

NE Daybreak Road/82nd Avenue;

NE 269th Street/NE Bennett Road/NE 61st Avenue/NE Bevin Road/NE J. A. Moore Road;

NE Hyatt Road/NE 82nd Avenue;

NE 284th Street; and

NE 279th-Street.

The following four off-site intersections were analyzed in detail:

NE J. A. Moore Road and NE 284th Street;

NE 61st Avenue/Bennett Road and Storedahl Pit Road;

NE Hyatt Road and NE Daybreak Road; and

NE 82nd Avenue and NE 279th Street.

The level of service analysis used for the study intersections follows the methodology described in the *Highway Capacity Manual* (Special Report No. 209, Transportation Research Board, Washington D.C., 1994). Intersection turn movement counts were conducted at the four study intersections from June 29 to July 1, 1998. See Appendix A for summaries of traffic volumes and turning movements. All study intersections were operating at level-of-service (LOS) C or better during both the morning and afternoon peak hours.[7] For rural areas in Clark County, the minimum acceptable level of service is LOS C.

A 24-hour speed survey was conducted along Bennett Road just south of Storedahl Pit Road. The 85th percentile speed was 51 mph northbound and 48 mph southbound.[8]

According to Clark County records, four accidents occurred in the study area between 1992 and 1996. Three occurred near the intersection of NE 82nd Avenue and NE 279th Street, the other at NE J. A. Moore Road and NE 284th Street. No fatalities were

[7] Level of Service categories are similar to report card ratings for traffic performance. Intersections are typically the controlling bottlenecks for traffic flow and the ability of a roadway system to carry traffic efficiently is generally diminished in their vicinities. LOS A, B, and C generally indicate conditions where traffic moves without significant delays over periods of peak travel demand. LOS D and E indicate progressively worse peak hour operating conditions and LOS F conditions occur when demand exceeds the capacity of an intersection. Most urban communities set LOS D as the minimum acceptable LOS for peak hour operation and plan for LOS C or better for all other times of the day.

[8] By definition, 15 percent of the vehicles surveyed were traveling faster than the 85th percentile speed and 85 percent of the vehicles surveyed were traveling slower than the 85th percentile speed.

recorded. For all study intersections, accident rates for the 5-year period were less than 1.0 accident per million vehicles entering each intersection.

No bicycle or pedestrian walkways are provided along the study area roads, and few pedestrians have been observed nearby in either the morning or afternoon peak periods. The little noticeable pedestrian activity relates primarily to children either waiting for school buses in the morning or walking home in the afternoon.

3.7.2.12 Effects and Mitigation of Alternative A-1 on Traffic and Transportation: Partition the property into 20-acre parcels and sell as rural residential/agricultural tracts

Effects. Traffic generated by the development of the property into 20-acre parcels would only slightly increase peak hour volumes, which currently allow the affected roads and intersections to operate above LOS C. As processing phases out, volumes would drop and roads and intersections would operate at an improved LOS. Driveways would be required to meet county standards, but no other mitigation measures would be necessary.

Mitigation. Traffic generated under Alternative A-1 would not reduce levels of service at the study intersections or other areas in the vicinity of the project below county standards. Other than county approval for the design of the driveways to the potential new tracts, no mitigation measures would be required.

3.7.2.13 Effects and Mitigation of All Mining Alternatives (A-2: Mine with no ITP, B: Preferred Alternative, and C: July 2000 HCP) on Traffic and Transportation

Effects. During peak operations (June through November), Storedahl transports approximately 4,000 tons of material per day from the project site (exports) and approximately 1,500 tons of material per day the remainder of the year. An average of 4,500 tons per day is currently transported to the project site for processing (imports) from the Tebo Surface Mine southwest of the project site. At peak operation, import activity increases to 5,000 tons per day. Most of the imports and exports are hauled in 30-ton capacity trucks, although cash sales, which represent approximately 15 percent of exports, are hauled in trucks of various sizes, with the average load being about 10 tons. Proposed on-site activities include mining, processing, sorting, and stockpiling sand and gravel. The projected daily export volume under these three alternatives is approximately 8,000 tons during peak operations and 3,000 tons the remainder of the year. Material imported from the Tebo Surface Mine would be reduced to approximately 2,500 tons per day.

Storedahl intends to mine approximately 4,000 tons of material daily at the Daybreak site during peak operations and transfer this material to the processing area by extending an existing on-site conveyor system to each proposed phase as it becomes active. Alternatively, raw material would be conveyed by trucks from the mining areas to the processing area via temporary onsite roads and/or NE 61st Avenue/Bennett Road/J. A. Moore Road, with access to the county road by three existing driveways. Although all three driveways would be needed, only one would be used at any given time. Employment would be constant under both alternatives and cash sales would continue to compose about 15 percent of export volume. If no conveyor system were used, then cash sales would be restricted until after 9:00 a.m. to minimize vehicle trips during the morning peak period.

Although the previous discussion includes hauling volumes for average and off-season levels on a daily basis, peak hour volumes only were analyzed to represent a worse case scenario of vehicle and truck trips.

Trip Generation/Distribution

The trip generation for mining activities at the project site was determined based on traffic counts conducted at the existing site access and information provided by Storedahl. The data used represent a typical day during the peak-operating season. Please see the transportation impact study (DKS, 1998).

Current operations generate approximately 79 trips, predominantly trucks, during the morning peak hour, the period with the higher volumes of the two daily peaks. Using the conveyor system, operations are expected to generate about 23 additional vehicle trips during the morning peak hour and 12 additional trips during the afternoon peak hour. Using only trucks, these numbers increase to 28 and 30, respectively. Trip distribution was based on existing traffic patterns in the study area and additional information provided by Storedahl (for specifics of trip distribution data, see Table 2 and Figures 3 and 4 in the transportation impact study). Trips were assigned to the road network on the basis of this distribution, and added project traffic was traced through the study intersections.

Intersection Capacity

Intersection capacity was evaluated for three scenarios: existing plus project (1998), future base (1999), and future plus project (1999). The existing plus project scenario provides the best indication of project-related effects on the roadway system without other land-use changes. Projected vehicle trips from the project were added to 1998 volumes to arrive at existing plus project volumes for both alternatives (Figures 5 and 6 in DKS, 1998). All four intersections would operate at LOS C or better during morning and afternoon peak traffic periods. See Table 3 in the transportation study for specifics on the resulting levels of service for the four study intersections.

The transportation study assumed that the proposal would become fully operational in 1999. Traffic volumes for the future (1999) base were estimated by increasing the 1998 volumes by 2 percent. The roadway network and geometries were assumed unchanged. The four study intersections would all operate at a LOS C or better during both the morning and afternoon peak traffic periods. See Table 4 in the transportation study for specifics on resulting levels of service for the four study intersections.

The Future (1999) plus project scenario represents full project operation. Traffic volumes were estimated by adding project traffic to the 1999 base volumes discussed above. For analysis purposes, roadway conditions were assumed unchanged. Figures 7 and 8 in Appendix A illustrate the future (1999)-plus-project traffic volumes for both alternatives. The four study intersections would continue to operate at LOS C or better during the morning and afternoon peak traffic periods. See Table 5 in the transportation study for specifics on resulting levels of service for the four study intersections.

Site Access/Sight Distance

Sight distance evaluation was based on the guidelines of the American Association of State Highway and Transportation Officials. The 85th percentile speed along Bennett Road is approximately 50 mph. Accordingly, a minimum sight distance of 500 feet is required along this county road.

Two separate options were considered for transporting the mined resource from each mine phase to the processing area. The preferred option is to extend a conveyor system from the processing area to each mine phase. The other option would involve using haul trucks to transport the raw mined resource from each mining phase to the processing area.

For Option 1 the only access point to the site would be Storedahl Pit Road. At this location, sight distance is more than 500 feet in both directions. Based on the estimated number of vehicles entering and exiting the project site, less than one vehicle per minute would exit the project site during the morning peak period. During the afternoon peak period, about one vehicle would exit the site every 1.5 minutes. This would not generate significant queuing for vehicles exiting Storedahl Pit Road.

For Option 2 , Storedahl Pit Road would remain the primary access point. However, three other existing driveways would be used one at a time to truck the mined rock from the operating phase to the processing area. Figures showing the sight distance requirements for all four access points are found in the transportation study. Two of the three driveways would be on the west side of NE 61st Avenue and one on the east. As with alternative 1 the traffic volumes generated by alternative 2 would not generate significant queuing for vehicles exiting any of the project access points.

Sight distances for the primary access to the site and the three driveways meet the county code requirements.

Weight Limits

The proposed project would generate trips by various vehicle types, ranging from small private vehicles to large trucks. Trucks serving the project site would continue to meet the load requirements specified in the Washington State Department of Transportation "Permits for Oversized Vehicles."

Mitigation. In general, few traffic effects would be created by the three mining alternatives as compared to Alternative A-1. Possible measures to reduce concerns about truck traffic include the following:

Improving street lighting at site driveways to increase afternoon and evening visibility during winter; and

Working with the school districts to identify school bus stop areas (where needed or not already provided) on key routes in the area.

3.7.3 Socioeconomic Environment

3.7.3.1 Utilities and Services -- Affected Environment/Baseline Conditions

The subject property and adjacent areas are designated by Clark County in its comprehensive plan and zoning codes as suitable for rural residential and resource production land use activities. Accordingly, the level of public services provided directly to the site and neighboring properties is nominal and consistent with the rural nature of the area.

Infrastructure in the area is limited. Basic rural roads provide access to the subject and neighboring properties either directly or via a network of connecting public and private roads. Electrical facilities are generally overhead and follow the road system, as do telephone lines. Stormwater is generally managed by roadside ditches that discharge to properties adjacent to the roads or to natural streams. All potable water sources and sanitary wastewater facilities serving developed tracts in the area are provided by on-site systems.

Other governmental services provided in the general area include schools and public safety. The subject property falls into two school districts, LaCenter and Ridgefield. School bus service is provided in the area along J.A. Moore Road, NE 61st Avenue, and Bennett Road. Law enforcement is provided by the Clark County Sheriff and fire protection is provided by Fire Districts 11 and 12.

Because of the rural nature of the project site, public utility and community facility service is limited to electricity, telephone, and emergency fire protection. The site is within both the La Center and Ridgefield school districts but does not require the services of either. A private operator maintains a 2-cubic-yard box on-site to collect solid waste.

3.7.3.2 Effects and Mitigation of Alternative A-1 on Utilities and Services: Partition the property into 20-acre parcels and sell as rural residential/agricultural tracts

Effects. Urban utilities do not extend to the vicinity of the project site. Development would not generate the need for public water, sanitary sewer, or storm sewers. Such development would, however, create a demand for additional telephone and fire protection services. It is also likely that the demand for solid waste collection would increase. Electrical facilities would be more widely distributed to provide service to each separate parcel. The three water wells and septic systems associated with the three existing dwellings would likely be abandoned as those dwellings, which are in marginal condition, are demolished by the subsequent property owners as a precursor to the construction of new homes. The number of school age children residing on the additional 14 tracts is anticipated to be small such that they could be absorbed into the two districts serving the site. No significant effects would result from the alternative action.

Mitigation. Because no significant adverse effect to any utility or service would occur as a result of this alternative, no mitigation activity would be required.

3.7.3.3 Effects and Mitigation of All Mining Alternatives (A-2: Mine with no ITP, B: Preferred Alternative, and C: July 2000 HCP) on Utilities and Services

Effects. Expansion of mining on the project site would have no significant adverse effect on any public utility systems or services. Electrical energy consumption is expected to increase nominally, but no additional facilities would be required; in fact, a short segment of electrical facilities powering an irrigation well would be removed as mining moves into Phases 4 and 5. Telephone service would not be affected and the need for fire protection, solid waste collection and disposal services would remain constant. Water wells and septic systems serving three dwellings on the subject property would be removed as mining progresses to those areas. Post reclamation partitioning and low-density residential development under Alternative A-2 would result in the installation of additional septic systems and individual water wells.

Mitigation. No significant effect to any utility system or public service would occur as a result of the proposed action. No mitigation measures would be necessary.

3.7.3.4 Noise—Affected Environment/Baseline Conditions

This section summarizes the existing acoustical environment in the vicinity of the proposed Daybreak Mine expansion project. The *Daybreak Mine Project, Noise Impact Assessment, Clark County, Washington* (Daly-Standlee & Associates, August 2000, Appendix B to this FEIS) discusses the environment in more detail (Note, the August 2000 report supersedes the June 1996 study appended to the Site Plan Review application submitted to Clark County in 1998). The mining plans analyzed in the August 2000 noise assessment were Alternatives A-2 and C. The mining footprints of those alternatives were similar; the mining footprint of Alternative B is the same except that the proposed mine pit west of Bennett Road and south of Storedahl Pit Road, labeled as P-1A in the noise assessment was deleted from Alternative B. All references to mine phases in this discussion are to the phase scheme illustrated in the drawings in the Daly-Standlee report.

Ambient noise is generally defined as the all-encompassing noise associated with a given environment, being usually a composite of sounds from many sources near and far. Ambient noise levels were measured in 1991 at nine residential properties near the proposed mining expansion area to determine a baseline of the acoustic environment before any changes occurred at the site. The measurement locations chosen were considered to represent the noise-sensitive properties in different directions from the mine expansion area having the greatest potential of receiving noise effects from the proposed expansion (Figure 3-27). As noted elsewhere, processing takes place intermittently, when the portable screening and crushing equipment is moved onto the site to replenish product inventory. During this intermittent processing since 1991, additional sound level data has been collected. The 1991 sound level data, rather than more recently measured data, was used to define the ambient noise baseline for the noise impact analysis because the original noise data were found to provide a more conservative assessment of noise effects. Thus use of the earlier sound data provided for more protection of the environment. The following table presents the results of the 1991 ambient noise measurements.

Table 3-2

Average Hourly Ambient Statistical Sound Levels (dBA) Measured in 1991 Around the Proposed Expansion Area*

Measurement Location	L_{max}	L_{03}	L_{08}	L_{25}	L_{eq}
A	62	53	52	50	53
B	64	51	48	46	49
C	77	70	64	50	61
D	77	66	62	55	58
E	63	51	49	47	48
F	67	58	53	49	55
G	66	54	52	49	49
H	67	55	53	51	51
I	75	55	49	47	50

* Sound levels are A-weighted decibels (dBA – see Appendix B)
L_{max} = maximum level during the hour
L_{03} = level exceeded 3 percent of the time during the hour (1.8 minutes)
L_{08} = level exceeded 8 percent of the time during the hour (4.8 minutes)
L_{25} = level exceeded 25 percent of the time during the hour (15 minutes)
L_{eg} = equivalent sound level (see noise study for detail)

Noise data for aggregate processing equipment were entered into a computer model, and the predicted sound levels were compared to levels measured at the nine residential properties to verify the model's accuracy. The model was then used to predict future sound levels at nearby residential sites and those levels were compared with existing sound levels and state and county criteria to determine possible noise effects.

3.7.3.5 Effects and Mitigation of Alternative A-1 on Noise: Partition the property into 20-acre parcels and sell as rural residential/agricultural tracts.

Effects. With this alternative action, noise from the processing plant would continue at present levels for the duration of on-site processing of imported material. Noise would also be associated with trucks continuing to deliver raw material or hauling processed rock. No change to these noise generators is expected with this alternative.

Noise generated by the residents of the 20-acre farms would be typical rural residential noise associated with construction, operation of agricultural equipment such as tractors and hay-bailers, and equipment repair.

Mitigation. No significant noise effects would result from the development of the 20-acre parcels and no mitigation measures would be necessary.

3.7.3.6 Effects and Mitigation of all Mining Alternatives (A-2: Mine with no ITP, B: Preferred Alternative, and C: July 2000 HCP) on Noise

Effects. The Washington Administrative Code (WAC 173-60-040) states that noise levels from an industrial site may not be louder than 60 dBA at a residential receiver between the hours of 7:00 a.m. and 10:00 p.m., or 50 dBA between the hours of 10:00 p.m. and 7:00 a.m.; except the maximum noise levels may be exceeded by no more than 5 dBA for fifteen minutes during any hour, by no more than 10 dBA for 5 minutes during any hour, and by no more than 15 dBA for 1.5 minutes during any hour. The Clark County SEPA policy (CCC 20.500.025(g)) states that an increase of more than 5 dBA over the ambient noise levels at the receiving property may be considered significant and mitigation should be considered. When both criteria are satisfied, it is expected that there would be no effect associated with the mining expansion operations.

Daybreak Mine noise associated with the three mining alternatives was predicted with a computer program using established acoustical sound propagation equations presented in reference materials such as the *Handbook of Acoustical Measurements and Noise Control, Third Edition* (Cyril M. Harris, McGraw-Hill Inc., 1991). To more accurately determine the effect of the proposed mining expansion on noise levels at residences around the site, sound sources at the Daybreak site were divided into three types: 1) the crushing and related equipment, 2) excavation related equipment, and 3) truck traffic. Predictions were then made of the amount of noise from each source type that would reach 17 residences around the site during the expansion of the mining area (the nine, 1991 ambient noise monitoring sites plus eight additional residences). The noise calculations included sound attenuation factors caused by topography, vegetation, distance, and atmospheric conditions. Table 3-3 presents the loudest L_{25} noise levels for combined excavation and crushing operations by mine phase for each of the 17 modeling locations. These unmitigated noise levels can be compared with the hourly L_{25} ambient noise levels measured in 1991 at nearby locations, as identified in Section 3.7.3.4.

Based on the assessment criteria specified by the Washington Administrative Code and the Clark County SEPA policy, significant noise effects would occur with all three mining alternatives if noise mitigation measures are not included in the mining plans. Therefore, from a noise standpoint, no one alternative is more desirable above another except that there would be no noise generated by mining activities southwest of Bennett Road under Alternative B.

The prediction results indicate that the continuation of processing operations at the project site and trucking operations would generate no additional effect on the residences around the site because there are no plans to relocate the processing equipment. Thus, it can be concluded that there would be no change in the amount of processing and trucking noise reaching any residence.

Table 3-3
Predicted Loudest Hour L_{25} Sound Levels from Excavation & Crushing Operations at the Daybreak Mine Site with Approved Expansion of the Mining Area
(levels in excess of the WAC limit are in bold)

Receiver	Crusher Noise (dBA)	Excavation Noise (dBA) (by phase)							Crushing plus Excavation Noise (dBA) (by phase)						
		1	2	3	4	5	6	7	1	2	3	4	5	6	7
1	44	49	**67**	46	40	42	34	34	50	**67**	48	45	46	44	34
2	48	**70**	**62**	51	46	49	40	42	**70**	**62**	52	50	52	49	48
3	46	47	55	55	43	43	37	37	50	56	56	48	48	47	47
4	46	47	51	58	44	44	38	38	50	52	58	48	48	47	47
5	46	46	49	**63**	45	45	39	39	49	51	**63**	42	49	47	47
6	46	47	51	**70**	51	51	42	42	50	52	**70**	52	52	47	47
7	46	48	51	**70**	52	52	43	43	50	52	**70**	53	53	48	48
8	46	48	51	**63**	**67**	56	44	44	50	52	**63**	**67**	56	47	47
9	46	48	51	**62**	**65**	55	44	44	50	52	**62**	**65**	56	48	48
10	46	46	50	55	**62**	53	45	45	49	51	56	**62**	54	49	49
11	46	45	44	46	**61**	50	52	52	49	48	49	**61**	51	53	53
12	46	40	38	38	45	43	55	48	47	47	47	49	48	56	50
13	48	40	38	38	45	43	55	48	49	48	48	50	49	56	51
14	48	40	38	38	45	43	55	48	49	48	48	50	49	48	48
15	48	41	46	54	43	43	37	37	49	50	55	49	49	48	48
16	46	43	42	42	38	40	38	38	48	47	47	47	47	47	47
17	50	39	39	39	38	39	39	40	50	50	50	50	50	50	50

The residences south of the East Fork Lewis River (locations 16 and 17) as well as some of those north of the river (locations 13, 14 and 15) are sufficiently far enough from any future excavation related noise sources that the expansion of the mining area would generate no significant change in noise levels at those locations. Noise effects from trucks and processing activities are also expected to be insignificant at those residences for the same reason. Thus it is concluded that expanding the mining area at Daybreak Mine site would have no effect on the noise levels at those residences.

For the remaining fourteen residences, expanding the mining area could have some measurable effect on the ambient noise at the residences if noise mitigation measures are not included in the mining plan. However, the effects will only be present during the time when mining operations occur in some phases and not necessarily during all phases. For instance, the noise from the proposed expansion of the mining area would exceed the WAC criteria and the County SEPA criteria at prediction location 1 only during the time when excavation occurs in Phase 2A. During all other times, noise from the expansion operation is expected to be less than that allowed by the two criteria.

At prediction location 2, if noise mitigation measures are not included in the mining plan, noise effects are expected to exceed both WAC and County SEPA criteria during extraction operations in mining Phases 1A, 1C, 2B and 2C. However, during mining operations in all other phases, noise effects at location 2 are expected to be insignificant. Note that under Alternative B, Alternative C mine Phase 1A has been dropped and would therefore not cause any noise standard exceedance.

If noise mitigation measures are not included in the mining plan, the loudest hour L_{25} noise level at locations 3, 4 and 5 is expected to meet the WAC criteria but exceed the County SEPA policy levels during Phase 2C (only at location 3) and Phase 3 (at all three locations). At all other times, the noise from the mining operations is expected to meet both state and county criteria without the use of any noise mitigation measures.

At prediction locations 6, 7, 8 and 9, the mining related noise is expected to exceed both the WAC noise criteria and the County SEPA criteria if mitigation measures are not included in the mining plan. At locations 6 and 7 this would occur during the excavation activities in parts of the Phase 3 area. At locations 8 and 9, this would occur during excavation operations in both Phase 3 and Phase 4. Noise generated during Phase 5 would meet the WAC criteria but slightly exceed the County SEPA policy at prediction locations 8 and 9 if mitigation measures are not used to reduce equipment noise.

At locations 10 and 11, unmitigated noise levels from Phase 4 operations would at times exceed both the WAC criteria and the County SEPA policy, while that from Phase 3 would be only slightly above the County SEPA policy criteria at location 10. The only residence that might be significantly affected by noise radiating from Phase 6 operations would be at location 12, where the WAC noise criteria would be met but the County SEPA policy may at some time be exceeded.

Excavation operations in Phase 7 are not expected to result in significant noise effects to any surrounding residences.

At some times during the mining activities in Phases 1 through 4, the highest hourly statistical noise levels are expected to be more than 5 dBA above the existing noise levels at prediction locations 1 through 11 and more than 10 dBA above the ambient noise levels at prediction locations 1 and 2, and locations 5 through 11 if noise mitigation measures are not included to reduce the noise from the excavation equipment. However, as stated above, mining related noise will not exceed those criteria at all locations simultaneously or at all times during the phases.

Mitigation. Noise generated by the any of the three mining alternatives would be mitigated to acceptable levels according to the criteria set by the Washington Administrative Code and the Clark County SEPA policy. Mitigation measures that could be used, independently or together, include using quieter excavation equipment in some areas or providing a barrier between the excavation equipment and the residences where noise levels would be of concern.

Noise mitigation measures would be implemented as recommended in the noise effect assessment report (Daly-Standlee 2000). The recommended mitigation includes the use of a Komatsu PC400 excavator to extract material in Phase 1D and in Phase 2B, 2C and 2D. (Refer to Section 2.2.1 for a more detailed description of the mine phasing and excavation activities.) In the other phases, the recommended mitigation is to begin mining in the different phase areas with the Komatsu WA 600 front-end loader at a location that is far enough from the residences to ensure the noise levels would not exceed the WAC levels or exceed the ambient noise at a receiver by more than 5 dBA. The front-end loader would be used to excavate down to just above the water table and once that point was reached, excavation would proceed with the front-end loader excavating toward the boundaries of the phase area. Where required, barriers would be constructed near the boundary of the phase area to further reduce the noise radiating from the front-end loader to acceptable levels at a residence. Once the first excavation lift is complete in a phase area, an excavator could be moved in to begin mining below the water table.

Noise reduction barriers (berms or walls) will be needed in some locations at the boundary of all phases except Phase 7. Barriers would be needed to comply with the WAC noise criteria at prediction locations 1, 2 and 6 through 11 and are desirable to comply with the County SEPA policy at locations 3, 4, 5, 10 and 12. Figure 3-28 shows the location of the noise reduction barriers and the heights of those barriers are detailed in the noise impact assessment report (Appendix B). Note that Alternative C mine Phase 1A is not included in Alternative B and therefore would not require a noise attenuation berm southwest of Bennett Road. With the barriers, the noise levels at all residences around the site would meet both State standards and County policy.

The mining sequence, with excavation and reclamation starting early in the project in the eastern portions of the property, would reduce the period of exposure to the excavator noise on the east side of Bennett Road and NE 61st Avenue. It would also allow the vegetative screening buffer in that area to mature before mining begins west of NE 61st Avenue/JA Moore Road. Post reclamation partitioning and low-density rural residential development are not expected to have significant noise impacts.

3.7.3.7 Visual Resources -- Affected Environment/Baseline Conditions

The project site and surrounding area consists primarily of agricultural land used mainly for pasture, low-density rural residential development, and small farms. Dominating the landscape is the East Fork Lewis River, with low ridges on either side of the valley floor. The landscape is covered with grasses and pasture, scattered pockets of trees in the valley but primarily along the river and on the sideslopes of the ridges, and some wetlands.

The proposed mining boundary is wholly on the valley floor, as are the existing processing area and product stockpiles. The processing equipment, stockpiles, and ponds resulting from previous mining, as well as the existing pastures, are visible from certain locations on the adjacent roads. Most of the existing and proposed mine expansion-site and processing area is visible from residences on the hillsides on either side of the valley. Many of the residences have been constructed in the last 10 to 15 years, if not more recently, and well after mining and processing of the site was started. Areas of pasture not planned for mining or related disturbance (e.g., haul roads, conveyor system, raw material stockpiles) would be planted, as soon as all permits are issued, with a variety of native conifer and deciduous trees and shrubs. The plantings would be a major step toward returning the site to its historical state and enhancing, creating and conserving fish and wildlife habitat, as shown on the photo simulations (Figures 2-4 through 2-9 and 2-11).

Outdoor lighting at the project site is limited to the processing area. Lighting was designed and installed to enhance security and create a safe working environment for equipment maintenance in the evening, after processing operations shut down.

Security floodlamps are located on the north, east, and west sides of the maintenance shop. The lamps illuminate the driveway approaches to the pull-through building. The lamp on the east side also illuminates the entrance to the processing area. The north-aimed lamp lights the two equipment fuel storage tanks and the roadway to the material stockpiles and processing equipment.

Lighting fixtures are installed on movable equipment and utility poles at six locations in the processing area to illuminate after-hours maintenance and repair activities and provide security from vandalism. Lamps are elevated between 27 and 45 feet above grade and are oriented downward at approximately 45 degrees toward the equipment. The lighting is turned on approximately one hour before dusk and extinguished at dawn.

The lamps are 1,000-watt, high-pressure sodium luminaries. The fixtures are directed downward to avoid glare on neighboring properties, but the light reflecting off the ground and stockpiles creates an orange glow around the processing area. The glow is discernible, especially from the few residences on the hill across the East Fork Lewis River and along the crest of the hill to the north, where vegetation has been removed. When there is low cloud cover, the light reflected from the ground bounces off the clouds and increases the glow.

3.7.3.8 Effects and Mitigation of Alternative A-1 on Visual Resources: Partition the property into 20-acre parcels and sell as rural residential/agricultural tracts

Effects. The processing area would continue to be visible from residences on parts of the bluffs south of the East Fork Lewis River and unvegetated areas north of the project site. Automobile drivers, bicyclists, and pedestrians would continue to have limited views of the processing equipment and stockpiles from the county road that crosses the property.

Partitioning and developing the site would result in 14 new residences and associated outbuildings on the valley floor. Depending on the tract owners, most of each parcel could be left as hay or livestock pasture or converted to production of viable crops on the limiting soils. None of these actions would create significant aesthetic effects.

Lighting at the shop and processing equipment would continue as at present because of the ongoing processing of imported material. This light would exist for the life of the processing operation, currently projected to be considered significant.

The residences and outbuildings associated with the small farm development would generate additional lighting and glare. Rural developments commonly have security lighting on and around the buildings similar to street and house lighting in urban areas, but at a lower density. Vehicle headlights might also be more prevalent under the alternative action because, while mining and product transport would occur only during daylight, additional residential traffic would occur during the night. Any additional light and glare produced under this alternative action would result from actions by individual property owners installing security and outside lighting, and generating after-dark traffic. These changes would not be considered significant.

<u>Mitigation</u>. Under this alternative, the processing area would continue to be visible from portions of the county road and the residences on the bluffs, as it is at present. At the end of processing, the equipment would be dismantled and removed from the site. The existing ponds would be reclaimed in conformance with DNR regulations. Development of 20-acre tracts would not create significant effects and no additional mitigation measures would be necessary. Views of the existing processing area from the hillsides cannot be altered, but once reclaimed and developed as one or more of the 20-acre tracts, would be consistent with the remainder of the property.

Floodlamps illuminating the processing area would be retrofitted with visors or hoods to reduce glare on neighboring properties.

3.7.3.9 Effects and Mitigation of All Mining Alternatives (A-2: Mine with no ITP, B: Preferred Alternative, and C: July 2000 HCP) on Visual Resources

<u>Effects</u>. Planned and existing site activities would be visible from some residences and roads along the ridges on either side of the river valley because of line-of-site elevation differences. Residents who can now observe the processing area and truck traffic would continue to do so, but as the vegetative buffers mature, the site would be less visible (Figures 2-4 through 2-9 and 2-11). Residents would most likely have views of the mining areas, raw material stockpiles, and conveyor system as the mining progressed through the various phases, but the views would change as the mined areas are reclaimed and the vegetative cover matures. The aesthetics of neighboring shoreline areas currently used as live stock pasture or under public

ownership would be only temporarily affected because mining would be conducted in phases and sequentially reclaimed.

Views of mining operations would be limited to daylight hours. Mining operations would not be illuminated after dark and would normally begin at approximately 6:00 a.m. (consistent with the county surface mining combining district standards, CCC 18.329.030 F) during the construction season (April through October) or when daylight provides sufficient visibility. During the late fall and winter months, mining would cease at the end of the normal workday or dusk, depending on the time of year. While much of the mining would be conducted below the existing grade, the elevation difference would allow oblique views of the excavator and working excavation areas. At, or above grade, equipment and stockpiles would also be visible where existing or new vegetation does not block views.

Views of the mining operations and the processing area from the valley floor would be more limited than views from higher elevations. Items likely to be visible to passing traffic include the conveyor system, the excavator crane and above-grade extensions or dragline towers, and raw material stockpiles. Because the excavation would take place below grade, visibility of mining activity would be limited from the road or residences on the valley floor.

No additional illumination is planned for the proposed mining activities. Mining would take place only during daylight hours and would thus not require artificial light in or around the proposed excavation areas during mining activity. Similarly, the conveyor system that would transport raw rock from the excavation areas would not require artificial illumination. Routine maintenance or repair of the conveyor system would be conducted during daylight hours, as would routine field maintenance or repairs to the mining apparatus. Night lighting would continue to be required at the rock-processing area for maintenance and repair activities at the end of the operating day, as well as for security. Installation of additional light fixtures is not anticipated.

Peculiar to Alternative A-2, following reclamation the site would be partitioned into7 to 10 20-acre tracts and developed for rural residential land uses. Views from the bluffs overlooking the site would include the resulting dwellings and outbuildings, along with the likely attendant security lighting during evening hours.

<u>Mitigation</u>. Areas of pasture not planned for mining or related disturbance (for example, haul roads, conveyor system, raw material stockpiles) would be planted, as soon as all permits are issued, with a variety of conifer and deciduous trees and shrubs. The plantings would be a major step toward returning the site to its historical state and enhancing, creating and conserving fish and wildlife habitat, as shown on the photo simulations (Figures 2-4 through 2-9 and 2-11).

Visors or shields would be installed on the tops of all existing floodlamp fixtures to reduce the amount of direct light to the residences on the south bluff of the East Fork Lewis River. The hoods would also direct more light to the working area.

A variety of measures are designed to mitigate other aesthetic effects of the mining operation. Early operational phases of the mine would take place east of NE 61st Avenue to accelerate the completion of mining and reclamation activities on the eastern portion of the property and move west, away from the existing residences. Other measures include constructing visual screens along NE 61st Avenue and individual noise berms or other structures around the perimeter of the mining boundary and along J. A. Moore Road, NE 61st Avenue, and Bennett Road. The 10- to 12-foot noise berms would be hydroseeded after construction to stabilize the soils and control erosion. Seeding would also help blend all earthen structures with the surrounding area. Artificial structures such as diaphragm fences intended to attenuate noise impacts would be setup and painted to minimize visual effects.

After mining on the applicable phase is complete and noise control is no longer necessary, the tall berms would be shortened to approximately 5 feet, recontoured, and planted with vegetation consistent with the rest of the reclamation plantings. The shorter berms would be planted to blend with the final vegetation plan and left intact at the completion of the various mining phases. Structures erected as noise attenuation devices as alternatives to the berms would be dismantled and removed from the site.

The visual buffer planned along NE 61st Avenue would be permanent. It would be constructed and planted to conform to the final reclamation vegetation planting scheme. Forest Stand C would be left intact to provide a visual buffer and supplement a temporary wall constructed along the mining area in Phase 2B as a noise attenuation device. Similarly, Forest Stands D, E and F would also be maintained in their current state to provide visual buffers and screens between the mining activity and adjacent residential properties or the county road. Post reclamation partitioning and development of low-density rural residential development under Alternative A-2 will result in impacts similar to Alternative A-1, but would likely be muted due to the fewer building sites which would be located within the pond, wetland and forested area.

3.7.3.10 Archaeological Resources -- Affected Environment/Baseline Conditions

Archaeological assessments were conducted on the project site in January 1997 and July 1998. (J. & J. Enterprises 1997 and Archaeological Services of Clark County 1998.) The first study included 18 acres of the site currently designated with the Surface Mining Combining District overlay. The second investigation covered the balance of the project site. Both studies were conducted according to Clark County Code 20.50.025(3)(k). A field reconnaissance was conducted at the request of Clark County in the area southwest of Bennett Road in the spring of 1999 in conjunction with a reforestation project in that area.

All of the investigations included researching background documentary and historical cartographic information, as well as field reconnaissance and subsurface excavations.

The surface reconnaissance consisted of inspecting soils exposed primarily by rodent disturbance. Only a small fraction of the site was available for inspection by this method. To supplement the field reconnaissance, both efforts included shovel test probes and the second included auger borings and backhoe pits. Copies of both reports are on file with the USFWS and Clark County.

The investigations identified few archeological finds. In the 1997 study, findings included occasional fire-cracked rock concluded to be of natural origins and limited pieces of porcelain and glass. The 1998 investigation yielded a few flakes of obsidian and several cryptocrystalline flakes of multiple colors. All of the studies concluded that further archaeological investigation was not justified.

3.7.3.11 Effects and Mitigation of Alternative A-1 on Archaeological Resources: Partition the property into 20-acre parcels and sell as rural residential/agricultural tracts

Effects. Because both the archaeological investigations conducted on-site concluded that the potential for finding additional cultural resources or artifacts was low, no significant effects would be likely from Alternative A-1.

Mitigation. This alternative action would have no effects on cultural resources and no mitigation measures would be necessary.

3.7.3.12 Effects and Mitigation of All Mining Alternatives (A-2: Mine with no ITP, Preferred Alternative, and C: July 2000 HCP) on Archaeological Resources

Effects. Because both the archaeological investigations conducted on-site concluded that the potential for finding additional cultural resources or artifacts was low, no significant effects would be likely from the mining, reclamation, or enhancement activities proposed under these alternatives.

Mitigation. As these alternatives would have no effect on cultural resources, no mitigation measures would be necessary.

3.7.3.13 Recreational Resources -- Affected Environment/Baseline Conditions

The project site includes aggregate processing, mined ponds and irrigated agricultural land. As such, it offers nominal recreational opportunities to the public in the neighborhood of the site. As private property, access to the site is limited.

The adjacent lower East Fork Lewis River is within the Lewisville to confluence segment proposed for designation “R” (recreational, in the Nationwide Rivers Inventory.) It does provide recreation opportunities such as fishing, rafting and swimming.

Storedahl permits limited general access during non-operational daylight hours for fishing in the ponds and from the riverbank in areas where vegetation does not preclude access. Pond fishing from the banks and non-motorized watercraft for catfish, bass, bluegill, and other fish occurs primarily from late spring through early autumn. Riverbank fishing accessed through the project site takes place during the traditional salmonid runs. There is no developed or improved boat access to the East Fork Lewis River from the project site.

The ponds, pastures, and wooded areas also offer wildlife habitat value to numerous terrestrial mammal and bird species. Storedahl allows access to these areas for wildlife observation during non-operational daylight hours only. The after-hours maintenance crews and site security personnel have observed limited hunting.

3.7.3.14 Effects and Mitigation of Alternative A-1 on Recreational Resources: Partition the property into 20-acre parcels and sell as rural residential/agricultural tracts

Effects. As the 20-acre tracts are segregated and sold to individual property owners, access to the ponds and East Fork Lewis River for fishing would be curtailed and eventually eliminated, as would access to the upland areas used for wildlife observation and occasional hunting. The new property owners would most likely be concerned about possible damage to their land, improvements, and livestock, as well as the disruption of their privacy, and could eliminate public access.

More importantly, partitioning the property into the small farm tracts would effectively eliminate the potential for the acquisition of a contiguous, undeveloped, and publicly or semipublicly owned greenbelt along the East Fork Lewis River corridor. Transferring the property to multiple private owners would result in a substantial impediment to fulfilling the goals and policies of the 1992 *Clark County Trails Bikeway System Plan,* the 1994 *Clark County Parks, Recreation & Open Space Plan,* and the 1992 *Clark County Open Space Commission Final Report,* and those of the 1997 comprehensive plan. These documents all envision a greenbelt and trail system between La Center and Moulton Falls.

Mitigation. Extending a trail along the county road right-of-way some distance from the river, would continue public access to the greenbelt up- and downstream of the project site. However, it would not allow for complete greenbelt continuity in a natural state, as proposed in Alternatives B and C. New tracts created under this alternative that would complete the greenbelt could be acquired through negotiations or condemnation by the county.

3.7.3.15 Effects and Mitigation of All Mining Alternatives (A-2: Mine with no ITP, Preferred Alternative, and C: July 2000 HCP) on Recreational Resources

Effects. Much of the current recreational activity on the project site would be unaffected by expanded mining. Fishing along the banks of the existing ponds is not likely to change, given that it is permitted only when rock-processing operations are shut down for the day or on weekends. Access to the East Fork Lewis River would continue via the access road and through the processing area.

Hunting opportunities would be significantly curtailed, if not eliminated. The pastures currently used for hunting would be converted as proposed mining or reclamation phases become operational. Mining operations would temporarily disrupt the environment and limited terrestrial habitat presently available, and thus reduce the attractiveness for hunting. Storedahl could terminate hunting privileges at any time, regardless of the proposal.

When the property is reclaimed from mining, converted to habitat, and gifted to a nonprofit entity for open space and limited recreation as proposed in Alternatives B and C, it would fulfill many of the goals and policies of the 1992 *Clark County Trails Bikeway System Plan,* the 1994 *Clark County Parks, Recreation & Open Space Plan,* and the 1992 *Clark County Open Space Commission Final Report,* as well as many of the goals and policies of the county's comprehensive plan. Depending on the proposed use of the site by the nonprofit recipient, the site could contribute significant open space along the river corridor. At a minimum, it could contribute to the desired east-west trail system between La Center and Moulton Falls. Controlled development and reclamation of the property under the guidance of the nonprofit recipient could also help fulfill most of the regional parks and special facilities policies regarding acquisition. It could increase recreational access to the river corridor and enhance the value of the neighboring public land by helping to form a large, better-managed, contiguous block of open space in a linear greenway along the river.

Under Alternative A-2 the property would be reclaimed as valley-bottom forest surrounding the mining ponds, which would be graded and revegetated for emergent wetlands around the pond perimeters. Some 7 to 10 tracts would be partitioned and developed for waterfront rural residential uses. Under this private ownership scenario, as with Alternative A-1, access to the property for recreational activities would be granted at the discretion of the owners. Development of any of the facilities planned by Clark County as described above would also be at the discretion of the property owners.

Mitigation. Recreational activities currently allowed by Storedahl would continue around the ponds and along the river during periods when the site is not operating. The ultimate reclamation and conversion of the property to fish and wildlife habitat and transfer of ownership to a nonprofit entity could change recreational opportunities. However, the value of recreational activities would be higher because of the habitat value created by the mine reclamation. No mitigation would be necessary to compensate for the nominal effects to current recreational activities.

3.7.3.16 Energy and Natural Resources-- Affected Environment/Baseline Conditions

Energy is consumed at the project site for two principal functions: powering the processing equipment, and vehicles. Electricity, supplied by Clark Public Utilities, is used to power the raw-material processing equipment and water pumps for rock processing. A small amount of electricity is used for such things as lighting, water well pumps, and office operations. Petroleum products fuel the rock-moving equipment and haul trucks. Two fuel storage tanks are maintained on-site to refuel both the truck fleet and the on-site equipment. The power line providing electricity to the water well in the pasture north of pond 1 will be decommissioned and removed as the mining progresses into Phase 5. Removal will follow Clark Public Utilities protocol and requirements. The well and its casing will be retired as required by the Washington Administrative Code.

Two natural resources are associated with this proposal. Excavation of sand and gravel is the object of the proposed action. The site contains a significant deposits volume of high-quality material that would help meet the demands for public and private construction projects throughout the region. The site has also been designated as Agricultural Resource Land. The county's comprehensive plan includes policies guiding the use of agricultural lands for mineral extraction and other nonagricultural related economic activities relying on agricultural lands.

3.7.3.17 Effects and Mitigation of Alternative A-1 on Energy and Natural Resources: Partition the property into 20-acre parcels and sell as rural residential/agricultural tracts

Effects. Developing the project site for the alternative action would most likely see a slight increase in electrical consumption to the end of the plant's operating life. Consumption would be for continued use of processing equipment and additional consumption by residences and farms on the segregated tracts. Diesel and other petroleum fuel consumption would continue as at present for the life of processing, with additional consumption by the vehicles and equipment used at each farm. At the end of processing, energy consumption would decrease as the additional tracts are developed at the reclaimed processing area.

Converting the property to 20-acre rural residential/small farm tracts would allow continued use of the property for agricultural purposes. However, there would be a net loss of agricultural land because of the development of multiple residences, attendant yards, driveways, accompanying outbuildings, and such. Further, the partitioning would result in agricultural operations that would most likely be less efficient and cost-effective than maintaining the current pastureland as a single unit.

Mitigation. There would be a nominal increase in energy consumption as the individual tracts develop and processing continues. As processing is phased out, energy use would decline. No mitigation would be necessary. The property that is not mined or developed could remain available for agricultural use. Because the alternative would be consistent with county regulations, no mitigation is necessary.

3.7.3.18 Effects and Mitigation of All Mining Alternatives (A-2: Mine with no ITP, B: Preferred Alternative, and C: July 2000 HCP) on Energy and Natural Resources

Effects. The expansion of on-site mining under all three mining alternatives would increase electrical consumption for the conveyor system transporting raw materials from the mine to the processing plant. The processing plant would experience little if any increase in electricity consumption, either daily, weekly, or monthly, because the volume of material projected to be processed would remain relatively stable. The lower fraction of sand and other fines in the on-site resources that would be processed, compared with the composition of that now imported, could allow the equipment to process the current daily volume using less electricity than at present. Because electricity is a substantial expense to the applicant, all equipment is maintained in efficient operating condition. Removal of the irrigation water well north of Pond 5 and attendant electrical facilities will reduce the amount electricity used by a very small amount.

Consumption of petroleum products is expected to remain at approximately the current levels. On-site equipment would be used to handle raw and processed material at the processing plant at about the same rate as in the past. Diesel fuel use by haul trucks may decline slightly because trips to import raw material from off site would be reduced by a projected 50 percent.

Mining of the project site and reclamation for fish and wildlife habitat would result in the existing pasture being removed from the county's inventory of agricultural production areas. The comprehensive plan identifies 64,440 acres of agricultural land (based on interpretation of 1990 aerial photography's) in the unincorporated areas of the county outside the urban growth areas of the cities. Removing this site from pasture production would reduce the total land area devoted to agricultural production by less than 0.25 percent. Although the Washougal loam and Washougal gravelly loam soil types were classified as prime farmland by the Soil Conservation Service, site experience has shown that water retention and fertility are low.

Reclamation of the mine for fish and wildlife habitat with a conversion to limited recreational uses under nonprofit ownership is consistent with the county zoning code. Clark County Code18.302.020 J. lists "public recreation, *scenic* and park uses, except that intensive uses such as public country clubs and golf courses are not permitted, except as conditional uses in the AG-20 and AF-20 districts" (emphasis added). The proposed reclamation and use under Alternatives B and C is also consistent with the comprehensive plan and would fulfill the applicable goals and policies of the Community Framework Plan and the Rural and Natural Resources Element.

Under Alternative A-2, post reclamation partitioning into 7 to 10 20-acre tracts for rural residential development would affect energy consumption similar to Alternative A-1, but to a proportionally lesser extent because of fewer dwellings.

Mitigation. No significant impacts to these systems would result from the alternative action and no mitigation measures would be necessary.

3.7.3.19 Water, Stormwater, Sewer, Solid Waste, Other Utilities and Services—Affected Environment/Baseline Conditions

Because of the rural nature of the project site, public utility and community facility service is limited to electricity, telephone, and emergency fire protection. The site is within both the La Center and Ridgefield school districts but does not require the services of either. A private operator maintains a 2-cubic-yard box on-site to collect solid waste.

Three residences exist on the property and all are owned by Storedahl. As the mining phases progress, these units would be demolished and their respective water wells and septic systems also would be excavated and disposed of at appropriate disposal sites or recycling centers. The septic tanks would be pumped before they are excavated and removed. Electrical facilities powering the irrigation well in the center of the proposed mine expansion area would be decommissioned and removed, along with the access/maintenance easement. This activity would occur through coordination with Clark Public Utilities. Wells servicing the residences would be abandoned in accordance with the requirements set forth in the Washington Administrative Code.

3.7.3.20 Effects and Mitigation of Alternative A-1 on Water, Stormwater, Sewer, Solid Waste, Other Utilities and Services: Partition the property into 20-acre parcels and sell as rural residential/agricultural tracts

Effects. Urban utilities do not extend to the vicinity of the project site. Development would not generate the need for public water, sanitary sewer, or storm sewers. Such development would, however, create a demand for additional telephone and fire protection services. It is also likely that the demand for solid waste collection would increase. Electrical facilities would be more widely distributed to provide service to each separate parcel. The three water wells and septic systems associated with the three existing dwellings would likely be abandoned as those dwellings, which are in marginal condition, are demolished by the subsequent property owners as a precursor to the construction of new homes. No significant impacts would result from this alternative action.

Mitigation. No significant impacts to these systems would result from the alternative action and no mitigation measures would be necessary.

3.7.3.21 Effects and Mitigation of All Mining Alternatives (A-2: Mine with no ITP, B: Preferred Alternative, and C: July 2000 HCP) on Water, Stormwater, Sewer, Solid Waste, Other Utilities and Services

Effects. The planned expansion of mining on the project site would have no significant adverse effect on any public utility systems or services. Electrical energy consumption would be expected to increase nominally but no additional facilities would be required; in fact a short segment of electrical facilities powering an irrigation well would be removed as mining moves into Phases 4 and 5. Telephone service would not be affected and the need for fire protection, solid waste collection and disposal services would remain unaffected. Water wells and septic systems serving three dwellings on the subject property would be removed as mining progresses to those areas.

Demand for increased electrical, telephone, fire and other services and utilities from the 7 to 10 residences resulting from the post reclamation partitioning under Alternative A-2 would increase similarly to Alternative A-1 on a proportionately lower basis.

Mitigation. No significant impacts to these systems would result from the alternative action and no mitigation measures would be necessary.

3.7.4 Summary of Effects on the Human Environment

Alternative A-1 would result in the least impact to the human environment during the short-term. Alternative A-2, B and C would produce limited negative effects on adjacent landowners due to increases in noise and visual impacts. All mining alternatives would provide mitigation measures to decrease these effects on adjacent landowners. Over the long-term, Alternatives A-1 and A-2 would result in a permanent but small increase in residential structures with a commensurate use of local emergency facilities, hospitals, schools, and roads. Further, use of the site for recreation would likely be lost under these two scenarios unless subsequent property owners were to allow public access for such activities.

In the case of Alternatives B and C, the potential to maintain the area as greenspace in perpetuity exists. In these two scenarios, the area could be accessed for recreational purposes and would, overtime, enhance the value of adjacent lands by providing vegetative buffers from road noise and restricting further development.

No impact to cultural resources would occur under any of the four Alternatives.

3.7.5 Analysis of the Cumulative Effects of the Alternative Actions on the Human Environment

Pursuit of Alternative A-1 would result in a development pattern on the subject property mimicking those land uses and activities in the vicinity. The cumulative effects of this type of development on noise, traffic, land uses, governmental services and utilities, planned development patterns or other aspects of the built or human environment would be comparable to, and increasing only by a proportional increment, those already occurring from the existing development. That is, the addition of up to 14 new large rural residential tracts, once on-going gravel processing ceases, would have little discernible cumulative effect on neighborhood, facilities or services provided. Similarly, the post-reclamation Partitioning and development of 7 to 10 sites Under Alternative A-2 would have little cumulative effect.

The cumulative effects of implementing Alternatives A-2, B and C should be considered in terms of short-term (for the duration of mining) and long-term (post mining and reclamation) periods. The direct effects of mining on the built environment are discussed above and would shift as each phase is started, completed, reclaimed and activities move to the next. While mining activity would be noticeable, the direct effects would be mitigated to required levels. However, the mining activity would likely reduce the potential for additional development to occur in the range of the vicinity where such direct effects would be most noticeable to residents. As mining activity in Phases 2 and 3 is completed and shifts to subsequent phases to the west, the direct effects would be further lessened to those areas where rural residential activities are planned and return the perceived desirability to those tracts that have the potential for increased development density. In the interim, the demand for governmental services or use existing facilities would be expected to remain at current levels.

3.8 Summary of Cumulative Impacts

The geographic Cumulative Effects Area varies in location and size by alternative and the environmental element analyzed and, in some cases, is primarily limited to that area proposed for coverage under the HCP, i.e., the Storedahl property and the East Fork Lewis River RM 6 to RM 10. Although the affected geographic area could include all of Clark County and the Portland metropolitan area, it is limited to the East Fork Lewis River basin due to the nature of the product and the fact that other sources could provide similar material should this source not be available.

Storedahl is a major supplier of crushed rock used for resurfacing city, county and state roadways in Clark County, and for the most part, this aggregate is used for maintaining and repairing existing roads rather than for constructing new roads. During robust economic times, such as the late 1990s, up to 50% of the aggregate from the Daybreak site was sold for use in public works projects. More recently, with the economic downturn, approximately 34% of the Daybreak aggregate has been used for public works projects. Some unknown portion of the aggregate sold from the Daybreak site is likely used for other projects, such as building foundations, driveways, sidewalks, and commercial building slabs.

Estimating newly created areas of impervious surfaces that may be constructed with aggregate from the Daybreak site would be entirely speculative. Individual transportation and construction projects generally require a number of permits which include either NEPA or SEPA review. Smaller projects would be subject to site plan review a the local level, requiring review of surface runoff and the effects of the runoff. Thus, project specific impacts would be evaluated in the course of the permitting process.

The East Fork Lewis River originates in the foothills of the western Cascades, draining an area of 212 square miles (Figure 3-2). The river flows westward for 43 miles, joining the Lewis River approximately three miles upstream from the Columbia River. The Columbia River then empties into the Pacific Ocean 87 miles downstream. The lower 5.9 miles of the East Fork Lewis River is tidally influenced (Hutton 1995b), but the tidal influence can extend as far as RM 7.3 when flooding coincides with high tide (FEMA 1991) (Section 3.1.2 in the FHCP). The Daybreak site is located in a flat alluvial valley adjacent to RM 8 on the East Fork Lewis River.

Approximately 56% of the upper East Fork Lewis River watershed is owned and managed by private forest products companies for timber production, 23% by WDNR, and the balance by the USFS (WCC 2000). Habitat conditions in the East Fork Lewis River have been significantly affected by past actions. Repeated large-scale stand-replacement fires burned large portions of eastern Clark County between 1902 and 1952, and these disturbances resulted in impacts on the hydrology, structure, composition, and age-class distribution of the plant communities, as well as riparian and instream habitats along the East Fork Lewis River (WCC 2000). The largest fire, the Yacolt Burn, occurred in 1902 and covered an estimated 238,900 acres of state, private and federal lands. Large fires burned repeatedly over portions of the same area, and some areas have burned over five times, with the last major fires occurring in 1952 (WCC 2000). Sediment loading, high stream temperatures, insufficient canopy cover, large peak flows, and soil productivity were probably at their worst soon after the large fires. Major flood events occurring in 1931 and 1934 were probably associated with rain-on-snow precipitation events that coincided with major fires (USFS 1995 as cited in WCC 2000). These floods have been linked to the flushing of historic gravel spawning habitat in the middle section of the East Fork Lewis River. According to WCC (2000), "snag habitat, number of pieces of large woody debris per mile of stream, and the vegetation structure, composition, and age-class distribution remain well outside historic conditions today, and are projected to remain outside historic conditions well into the future." These conditions continue to contribute to the turbidity and excessive temperatures currently exhibited in the lower East Fork Lewis River.

Prior to EuroAmerican settlement, the lower East Fork Lewis River was a braided channel with extensive associated wetlands (Section 3.3.1 and Figure 3-7 in the FEIS). By 1937, development of farmland and infrastructure to support these agricultural activities had confined the river to a single thread channel, bordered by a system of ephemeral floodplain sloughs (Collins 1997). From the 1930s through the 1960s much of the wetlands and sloughs were drained, filled, and converted to agricultural land, and road densities had increased. Between 1960 and 1990 the population of Clark County increased by 154% (Hutton 1995b). Currently, Clark County is one of the fastest growing counties in the state. The effects of historical and continued development include increased runoff volumes and flood peaks along tributary streams, removal of riparian vegetation, and tributary downcutting and bank erosion as a result of altered hydrological conditions. In several places, roads and bridge crossings now confine the migration boundaries of the East Fork Lewis River. In addition, several public and private roads present practical barriers to the potential migration of the river, and just upstream of the Daybreak site, the Daybreak Bridge directs the East Fork Lewis River flow toward the south valley wall.

Mining of copper and gold near the headwaters of the East Fork Lewis River began in the 1890s, but came to an abrupt end following the Yacolt Burn in 1902. There are reportedly some 300 active mineral mining claims within the East Fork Lewis River basin (USFS 1995). It is not known when aggregate mining first began in the lower East Fork Lewis River, but gravel mining began in about 1940 in most Washington river basins (Collins 1997). Several historical mines were located within the hydrologic floodplain of the lower East Fork Lewis River, including County 1 and 2, Mile 9 Pit, the Ridgefield pits, and the existing Daybreak ponds (Figure 3-10 in the FEIS). There is an open pit which has historically mined fine-grained fill from the lower member of the Troutdale formation north of the Daybreak Site, and adjacent to Dean Creek. However, active mining has stopped at this site, and in July 2003 Clark County notified the owner that "…in order for the mining operation at the site to continue, the operator and/or property owner must promptly apply for site plan review and any necessary permits." Although other mines are located on the high terraces above the East Fork Lewis River, no other mines are known to exist or are in the planning stage within the geomorphic floodplain of the river.

Historical gravel mining activities in the vicinity of the proposed project have influenced the morphology of the East Fork Lewis River. In 1995, the river avulsed into the abandoned Mile 9 gravel pit causing the abandonment of a large meander bend (Figure 3.5 in the final HCP). During the February 1996 flood, the river broke into the southeast corner of Ridgefield Pit 7, flowing back into the channel at its northwestern-most point (Miller 1996). This caused abandonment of approximately 1,500 feet of channel located southwest of Daybreak Pond 5. In November 1996, the river migrated into Ridgefield Pit 1, flowing back into the channel from Pit 7, again relocating a section of the main channel of the river. The avulsions into abandoned gravel pits have altered the hydraulic and sediment transport characteristics of the river, and these characteristics constitute the existing, baseline conditions analyzed in the HCP and EIS.

Significant steps have been taken to preserve existing habitat and to enhance degraded habitat on the lower East Fork Lewis River. Clark County established a water quality monitoring network; enacted a number of ordinances regarding storm water and erosion control requirements; placed limitations on the location of potential contaminants within designated critical aquifer recharge areas; and, notably, restricted mining in the 100-year floodplain (State of Washington 1998). The County also currently levies a conservation futures tax, i.e., 6.25% real estate transaction tax (RCW 84.34.230), which funds the acquisition of open space lands. Over the past decade, Clark County and a variety of conservation oriented groups have acquired approximately 1,600 acres of floodplain and riparian habitat in the area as part of the East Fork Lewis River greenbelt. Habitat enhancement projects have been completed in the lower East Fork Lewis River in the past several years, some with assistance from the LCFRB and funded through the SRF Board. The Clark County Conservation District completed a floodplain restoration project on Lockwood Creek, downstream of the Daybreak site near RM 4. Storedahl provided a portion of the “match” funding for that project by donating services and equipment. More recently, Pacific Rock Environmental Enhancement Group, Inc. implemented a restoration project at the Ridgefield Pits that was designed by Storedahl’s consultants, R2 Resource Consultants, and donated to the project (see HCP Technical Appendix B). Storedahl also donated labor and equipment to that project as part of the funding match for the project. Fish First recently completed an enhancement project for chum salmon in an off-channel site downstream from the Daybreak Site. Fish First has also served as the primary sponsor for two riparian and wetland planting projects along the East Fork Lewis River near LaCenter. Upstream from the Daybreak site, the Lewis River Ranch, a privately held, natural resource-based business, owns approximately two miles of shoreline on the East Fork Lewis River and has engaged in various riparian restoration projects ranging from streamside planting to surface mining restoration and enhancement of off-channel habitat. Short-term benefits of these projects range from additional spawning habitat to reductions in local erosion. Long-term benefits will include improvements in floodplain function, increased riparian shade, and greater availability of large wood for instream habitat. In addition, the LCFRB is in the process of completing a Recovery Plan for Washington’s portion of ESU #4, which includes the East Fork Lewis River. That plan will describe and prioritize actions to ensure the recovery of the listed salmonid species in ESU #4, over the next century.

At the project site level, the existing Daybreak ponds and the path of the East Fork Lewis River through the Ridgefield Pits constitute the existing, baseline conditions. Past effects of the avulsions into the Ridgefield Pits, and future recovery as well as the potential for future avulsions into the existing Daybreak ponds were discussed in detail in Technical Appendix C and Addendum 1 of the HCP. Notably, infill and recovery of the Ridgefield Pits was projected to take several decades, at which time the probability of channel migration in the East Fork Lewis River would be expected to increase. An increase in the rate and/or magnitude of channel migration would result in an increased probability of bank erosion, which could lead to a potential avulsion into the existing Daybreak ponds. An analysis of avulsion potential at the Daybreak site, indicated that the most likely avulsion paths would be into the existing Daybreak ponds as opposed to into ponds created during expanded mining activities (Technical Appendix C of the HCP). Although considered to be unlikely during the term of the ITP, an avulsion into Daybreak Pond 1 was considered most probable path for the river to avulse in the foreseeable future.

Future conditions in the upper, forested watershed could be impacted by increased forest fires as a result of global warming and its attendant drought conditions. Without increased forest fires, cumulative actions in the upper East Fork Lewis River watershed are expected to include maturation of existing forests, as well as continued harvest of portions of the forest. In addition, harvest under the new Forest and Fish rules (promulgated by the State of Washington and are being considered for 4(d) coverage by NOAA Fisheries/NMFS) limits activities in riparian areas. This should result in improved salmonid habitat over the long term, including reductions in erosion, turbidity, and stream temperatures, and increased large wood recruitment.

Future conditions under continuing global warming were considered, based partially on information disseminated by the Climate Impacts Group at the University of Washington.

Global warming predictions suggest wetter winters and drier summers in the future. The most significant change for water resources will be a reduced snow cover in coming decades. During the winter, warmer temperatures will mean that precipitation falls less as snow and more as rain, reducing the amount of water stored as snowfall and released over a relatively longer period of time (as opposed to rainfall). Higher winter runoff will increase peak river flows and the likelihood of floods, mostly in lower elevation river basins. Less snow means earlier and lower spring runoff and less water available for summer use. "The future, therefore, probably holds increases in winter flooding and - paradoxically - increases in summer drought," (Mote et al. 1999). One of the potential effects of global warming is flashier flood flows. If future drought conditions do not include significant forest fires, the maturation of upper watershed forests and wider riparian buffer zones will aid in reducing the magnitude of these extreme high flows.

Increased rural development will undoubtedly continue, but has some finite limit under the existing local development regulations, and will not encroach on those floodplain and riparian areas, which have been preserved under the greenbelt program. Continued acquisitions and additions to the East Fork Lewis River greenbelt are expected, albeit at an unknown level. Additions and continued enhancement activities in the greenbelt are expected to result in long-term benefits to salmonid habitat in the East Fork Lewis River. However, development and its attendant impervious surfaces will increase runoff and peak flows and exacerbate low-flows. These effects could be potentially magnified by the effects of global warming on stream flows. The Climate Impacts Group has suggested several options to ensure that future water supply is adequate for future demand. These options include new technology to increase water use efficiency, and encouraging water conservation during seasonal lows. The HCP includes implementation of a closed-loop clarifier system (CM-01, Closed-Loop Clarification) to increase water use efficiency and the subsequent donation of groundwater rights to the State Trust for instream flow enhancement (CM-03, Donation of Water Rights), which will support continued summer base flow to the lower East Fork Lewis River, and consequently provide a benefit to cumulative impacts predicted under global warming. Site development under the HCP would preclude construction of homes and infrastructure on the site, and attendant increases in impervious surfaces and runoff.

Of all the cumulative effects of reasonably foreseeable future actions, the fate of the existing Daybreak ponds, following recovery of the Ridgefield Pits is perhaps the greatest concern in the lower East Fork Lewis River. The Services believe the effects from a potential avulsion would result in the greatest adverse cumulative impacts to the aquatic habitat for the covered species. The cumulative effects resulting from an avulsion include short- and long-term effects and effects occurring upstream, downstream, and locally. The extent of these cumulative effects would vary depending on each alternative analyzed in the EIS. For example, without implementation of the HCP, the ponds would likely be reclaimed per the Washington Surface Mine Act to include sinuous shorelines and emergent wetlands, without specific reclamation and long-term funding to reduce the potential avulsion threat and to reduce the extent of adverse effects from an avulsion. Additional adverse cumulative impacts would also be strongly influenced from the final land use proposed for the property.

Cumulative impacts of the alternatives on each environmental element analyzed are discussed in Chapter 3 of this FEIS. Specific discussions of cumulative effects of the alternative actions on the selected environmental elements were included in Section 3.2.5 regarding topography, climate, air quality, geology and soils; 3.3.4 regarding floodplain; 3.4.6 regarding surface water; 3.5.7 regarding groundwater; 3.6.5 regarding fish and aquatic habitat, and 3.7.5 regarding the human environment. Table 3-4 below provides a summary of the analyzed cumulative effects of each alternatives on environmental conditions.

Alternatives A-1 (Rural Residential Outcome) and A-2 (Mining and Reclamation without HCP/ITP) included continued aggregate processing at the site, with A-1 relying solely on imported materials and A-2 including mining on the site but undertaken so as to avoid take. The end use under these two alternatives would be the partitioning of the property and sale as rural residential building sites, similar to the existing rural setting around the Daybreak site, albeit at a lower density. During the period of continued processing at the site, the most likely response to the threat of avulsion or an avulsion event along the Storedahl Pit Road or in the processing area would be an engineered, structural solution, such as bank hardening, and rerouting of the river back into the historic channel. It is reasonable to expect a similar "emergency" response to avulsion should an avulsion occur following land partitioning and development to protect public and private infrastructure and property. These protective actions could be limited to points of immediate avulsive or erosive attack, or could occur along as much as 8,000 feet of the East Fork Lewis River bank from the Daybreak Bridge downstream to the western Storedahl property line, i.e., below Pond 5. This would amount to a 25% increase in the amount of channel with bank hardening along the lower East Fork Lewis River, which could result in long-term changes in the ability of the channel to migrate, to create off-channel habitats, and to recruit natural sources of LWD and gravel.

Alternatively, in the absence of emergency responses to prevent an avulsion, the same avulsion potential and sediment transport effects associated with current conditions would exist under Alternative A-1 (Rural Residential Outcome) and A-2 (Mining and Reclamation without HCP/ITP). Material processing that would occur under these alternatives could range from dry screening to wet washing. Fine sediments resulting from processing would be placed in and around the existing ponds. This material would be in addition to any fine sediment already in place in the ponds from historical gravel processing activities at the site. The placed sediments could be entrained should the East Fork Lewis River avulse into the ponds. Although the volume of sediments entrained would be dependent on how the avulsion occurred and evolved, short-term effects could include sediments being deposited within the 1.5-mile reach of spawning habitat downstream of the site, although the majority of the fine sediments entrained from the ponds would be transported downstream to the tidally-influenced reach of the river within a period of days. Long-term effects would include headcutting that would affect the upstream channel, reduced sediment supplies to the downstream channel, and an increase in open water habitat. It is estimated that the existing Daybreak ponds would take approximately 30 years to substantially fill with sediment should an avulsion occur under Alternative A-1 or A-2.

Table 3-4
Summary of Cumulative Effects under each alternative analyzed in the FEIS for the Storedahl FHCP.

	Alternative A-1 Rural Residential Outcome	**Alternative A-2 Mining and Reclamation without HCP/ITP**	**Alternative B Preferred Action**	**Alternative C July 2000 Draft HCP**
Topography, Climate, Air Quality, Geology, and Soils	There would be only nominal changes to these elements on site with 64 acres of open water and emergent wetlands, and no significant cumulative effects.	Cultivated fields will be converted to 149 acres of open water and 50 acres of emergent wetlands. There should be no off-site effects. A few other mines in the basin are independently operated which will have some effect, but not visible from the project site; the adjacent mine status is undetermined. No significant cumulative effect.	Same as A-2, except the resultant open water will include 102 acres of open water and 84 acres of forested and emergent wetlands. No significant cumulative effect.	Same as A-2, except 133 acres of open water and 55 acres of emergent wetlands. No significant cumulative effect.
Floodplain	Development of rural residential and agricultural uses may result in habitat modifying flood and bank protection implemented, in cooperation with other property owners, along 8,000 feet of shoreline. These measures could restrict channel migration and its associated functions. Residential development could disturb existing forested areas and related wildlife over the long term. The amount of revegetation of agricultural lands as	Essentially the same as A-1, but with 4 acres of upland forest lost and 4 acres preserved and 97 acres restored for a total of 101 acres of riparian and forested floodplain. Potential for significant cumulative effects related to floodplain/avulsion protection measures.	Lack of development would reduce the need for flood and bank protection. Monitoring would allow the preferred use of bioengineered bank protection should an avulsion threat develop. Engineering structures would be used only as a last resort and could be removed if desired to restore natural functions. Reconfiguring the existing ponds will reduce adverse effects, shorten recovery time, and provide the opportunity to adaptively manage recovery, should an	Similar to B, the lack of development would preclude the need for flood protection. Avulsion potential monitoring would last only for the life of the ITP. Bioengineered protection measures preferred with engineered solutions used as a last resort, which could remain, potentially restricting channel migration. Because the ponds will likely remain deeper the time for recovery would be much longer, and similar to Alternatives A-1 and A-2 under this

	Alternative A-1 Rural Residential Outcome	Alternative A-2 Mining and Reclamation without HCP/ITP	Alternative B Preferred Action	Alternative C July 2000 Draft HCP
	upland forest is unknown, but would likely be less than under other alternatives due to residential and small farm use. Potential for significant cumulative effects related to floodplain/avulsion protection measures.		avulsion occur. 8 acres of upland forest preserved and 106 acres reserved as upland forest. Reduced avulsion risk and reduced long-term cumulative effects from a potential avulsion.	alternative. 8 acres of upland forest preserved and 104 acres of upland forest restored. Potential for long-term significant cumulative effects from a potential avulsion.
Surface Water	The volume of surface water would remain approximately the same as existing conditions, i.e., 64 acres, with maximum depths ranging from 16 to 20 feet, because mining would not occur. Pond evaporation would continue at approximately 0.4 cfs. Development of site for rural residential or agricultural uses may contribute to degraded water quality similar to other developed properties in the vicinity, with increased stormwater runoff carrying nutrients and contaminants such as fertilizers, herbicides, pesticides, and fecal coliform. During the mining period, process water treated with additives would maintain	The existing 64 acres of ponds would remain the same as Alternative A-1. There would be an increase to a total of 149 acres as new surface water would be created from new mining ponds, and the maximum depth of the new ponds would be approximately 30 feet. Increased pond surface area would result in increased evaporation, estimated at 0.93 cfs. Post mining development would yield runoff similar to A-1, but at a lesser extent because fewer tracts would be developed. Process water discharges would be at or below permitted levels for all criteria. No change from current conditions.	The existing 64 acres of existing ponds would be reconfigured, area and volume significantly reduced, and the maximum depth of Pond 1 reduced approximately 10 feet (volume reduced 70%), Pond 2 reduced approximately 16 feet (volume reduced 55%), and Pond 3 reduced approximately 20 feet (volume reduced 70%). The depth of the new ponds would be approximately 30 feet Total pond area would be 102 acres, result in increased surface area and pond evaporation of approximately 0.63 cfs. Donation of the water rights to the State Trust for instream flow would more than off-set	The existing 64 acres of ponds will increase to 133 acres. Depths of the existing and new ponds will be the same as Alternatives A-1 and A-2. The addition of new ponds would result in increased pond evaporation, estimated at 0.83 cfs. Process water treatment and the control of the Dean Creek discharge will be the same as for Alternative B for the term of the HCP, but there will be no donation of water rights for instream enhancement or conservation easement. These actions will result in net benefits to existing local surface water systems, albeit not to the extent of the preferred alternative.

	Alternative A-1 Rural Residential Outcome	Alternative A-2 Mining and Reclamation without HCP/ITP	Alternative B Preferred Action	Alternative C July 2000 Draft HCP
	discharges from the existing ponds at levels equal to or less than the permit criteria. Potential for adding to cumulative decrease in water quality.		the increased evaporation (see Groundwater discussion below). In addition, the implementation of a closed-loop clarifier, water management plan, and conservation easement will improve water quantity and quality resulting in improved conditions.	
Groundwater	Water rights of 330 afy would be leased or sold. Up to 70,000 gpd of groundwater, exempt from water rights, could be withdrawn by 14 new dwellings/farms, or approximately 78 afy. This equates to a summer irrigation season reduction of approximately 1.19 cfs in base flow to the EFLR, or about 1% of the mean August flow. There would be a cumulative increase in groundwater withdrawal in the basin.	Water rights of 330 afy would be leased or sold. Up to 50,000 gpd of groundwater, exempt from water rights, could be withdrawn by the 7 to 10 post-mining dwellings. This equates to a summer irrigation season reduction of approximately 1.16 cfs in baseflow to the EFLR, or about 1% of the mean August flow. There would be a cumulative increase in groundwater withdrawal in the basin.	Donation of 330 afy water rights to the State Trust for instream flow. This equates to a summer irrigation season increase of approximately 1.08 cfs in baseflow to the EFLR, or about 1% of the mean August flow. There would be a reduction in cumulative groundwater withdrawal in the basin.	Water rights of 330 afy would be leased or sold. This equates to a summer irrigation season reduction of approximately 1.08 cfs in baseflow to the EFLR, or about 1% of the mean August flow. There would be no change in cumulative groundwater withdrawal in the basin.
Fish and Aquatic Habitat	Potential aquatic habitat changes due to flood protection/avulsion prevention measures installed to protect improvements on developed tracts. Up to 8,000	Similar to A-1. Some ecosystem contribution through valley bottom forest recreated as part of mining reclamation.	Entire site would be reclaimed to valley bottom forest and various backwaters and wetlands. The property would be gifted to a not-for profit organization(s) with a	Similar to B, the site would be reclaimed and gifted to a not-for-profit agency(ies), without the endowment.

	Alternative A-1 Rural Residential Outcome	Alternative A-2 Mining and Reclamation without HCP/ITP	Alternative B Preferred Action	Alternative C July 2000 Draft HCP
	ft of bank protection added to 30,000 ft of hardening between Lewisville Park and LaCenter, resulting in lost opportunities for channel migration and related geomorphic evolution. Opportunities for adding valley bottom forest and wetland habitat to the eco-system substantially diminished because of the multiple ownerships and development, resulting in adverse cumulative impacts.		conservation easement on property along with an endowment to manage the site in perpetuity. A bond to ensure funding to prevent or respond to an avulsion would reduce the adverse effects of such an event during the life of operations. This approach could add almost 20 percent to the existing 1,600 acre greenbelt along the EFLR, thus resulting in a cumulative positive impact.	
Wildlife and Terrestrial Habitat	Development for rural residential/agricultural uses would reduce the existing, limited terrestrial habitat and virtually eliminate the potential for adding the property to the EFLR greenbelt, thus reducing the contribution of the site to the lower EFLR eco-system and resulting in cumulative adverse impacts.	Reclamation of the property after mining would re-establish limited terrestrial habitat associated with valley bottom forest, but private ownership and subsequent development for rural residential use would effectively prohibit inclusion of the site in the EFLR greenbelt resulting in cumulative adverse impacts.	Site would be reclaimed, re-establishing terrestrial habitat. Fee simple transfer of the site to a not-for profit agency(ies) with an endowment and conservation easement will make the site ready for inclusion in and expansion of the EFLR greenbelt resulting in cumulative benefits to the ecosystem..	Habitat would be restored similar to B, but without the endowment or easement. Still, the site would be ready for inclusion in the EFLR greenbelt, resulting in cumulative benefits to the ecosystem..

	Alternative A-1 Rural Residential Outcome	Alternative A-2 Mining and Reclamation without HCP/ITP	Alternative B Preferred Action	Alternative C July 2000 Draft HCP
Human Environment	Development for rural residential/agricultural uses would add similar activities to the existing development in the vicinity. No adverse cumulative effect.	Continuing mining could inhibit development in the vicinity, but ultimately, reclamation of the site and post mining development would add uses similar to those existing in the neighborhood. No adverse cumulative effect.	Mining could inhibit short-term development in the vicinity. In the long term, the reclaimed natural setting would increase the desirability of the surrounding area as a rural residential setting. Cumulative effects would be beneficial.	Same as B. Cumulative effects would be beneficial.

Under Alternative A-2 (Mining and Reclamation and Avoid Take without Implementation of HCP/ITP), additional mining would occur over about 114 acres to create new ponds north of the existing Daybreak ponds. The new ponds would be located outside of the area of all historic channel locations, the current CMZ, and the 100-year floodplain. However, added measures to prevent an avulsion into these new ponds, such as increased buffer widths along the existing Daybreak ponds (CM-08, Mining and Reclamation Designs) and monitoring and maintenance (CM-09, Contingency Plan) would not be implemented. An avulsion into the existing ponds would increase the potential for further channel avulsions into the proposed ponds, although their position above the elevation of the 100-year floodplain make such an additional avulsion unlikely. The increased volume and size of the adjacent new ponds would increase the magnitude and duration of associated sediment transport effects should the river also avulse into the new ponds. It was estimated that it could take several hundred years for the existing and proposed ponds to substantially fill with sediment, in the unlikely event that the East Fork Lewis River avulses into both the existing and new pond areas (Technical Appendix C, Table 5-5 in the HCP).

Under Alternative B (Preferred Action), new mining would occur on about 101 acres. The new mine ponds would be located outside of the area of all historical channel locations, the current CMZ, and the 100-year floodplain. Numerous conservation measures would be implemented to resist an avulsion into the existing Daybreak ponds, minimize the effects of an avulsion should it occur, and minimize adverse effects by reducing the associated recovery time. The existing Ponds 1 through 4 would be substantially shallowed, narrowed, reshaped, and the shoreline revegetated to forested and emergent wetlands. The restoration of native valley-bottom forest would increase the buffer width and integrity between the river and the existing ponds and between the existing ponds and the proposed ponds. The increased width and vegetated areas would aid in resisting an avulsion through increased bank erosion resistance and increased overbank hydraulic roughness. Reducing the depth of the existing Pond 1 to an elevation approximately equal to the thalweg of the existing channel would reduce the energy gradient into the existing pond and reduce the extent of resulting headcutting if the East Fork Lewis River were to avulse into this pond. Filling and reshaping the existing Ponds 1 through 4 to make them shallower and narrower and would reduce their volume and their potential to trap sediments. This would aid in reducing the time necessary to restore the supply of sediment to the downstream channel should an avulsion occur. Under this alternative, it is estimated that in the event of an avulsion, recovery of the existing ponds could take as little as 6 years. It is estimated that it would require up to several hundred years to substantially fill the proposed ponds, in the unlikely event that the channel migration extends to them.

Approximately 571,000 cubic yards or 685,000 tons of clean fill would be added to the existing Daybreak ponds under conservation measures in Alternative B. This material would be in addition to fine sediment already in place from historical gravel processing at the site. In the event of an avulsion, these sediments could be entrained in the flow of the East Fork Lewis River. The volume of material entrained would be dependent on how the avulsion occurred and evolved. In the short-term, sediments could deposit within the 1.5-mile reach of spawning habitat downstream of the site, although it is expected that the majority of fine sediments entrained from the ponds would be transported downstream to the tidally-influenced reach of the river within a period of days.

Alternative C (July 2000 Draft HCP) proposed to conduct additional mining as described under the July 2000 working draft of the HCP. New excavation would occur over an area of about 114 acres. Similar to Alternatives A-1 and A-2, this alternative does not include significant modifications to the existing Daybreak ponds. The effects of a potential avulsion into the existing ponds are therefore similar to those previously described for Alternatives A-1 and A-2. Additional mining would occur to create new ponds north of the existing Daybreak ponds. The new ponds would be located outside of the area of all historical channel locations, the current CMZ, and the 100-year floodplain. However, the same avulsion potential as for existing conditions would exist and further avulsion potential into the new ponds would be created. Similar to Alternatives A-1 and A-2, long-term effects from an avulsion would include headcutting that would affect the upstream channel, reduced sediment supplies to the downstream channel, and an increase in open water habitat. An avulsion into the existing ponds would increase the potential for further channel avulsions into the proposed ponds, although their position above the 100-year floodplain make such an additional avulsion unlikely. The increased volume and size of the adjacent new ponds would increase the magnitude and duration of associated sediment transport effects should the river also avulse into the new ponds. It was estimated that it could take several hundred years for the existing and proposed ponds to substantially fill with sediment, in the unlikely event that the East Fork Lewis River avulses into both areas (Technical Appendix C, Table 5-5 in the HCP).

Material processing to be conducted under Alternative C could range from dry screening to wet washing. Fine sediments resulting from washing the material would be placed in and around the existing ponds. This material would be in addition to fine sediment already in place within the existing ponds from historical gravel processing activities. Sediments placed in the ponds could be entrained should the East Fork Lewis River avulse into the ponds. The volume of material entrained would be dependent on how the avulsion occurred and evolved. Although in the short-term, sediments could deposit within the 1.5-mile reach of spawning habitat downstream of the site, it is expected that the majority of the fine sediments entrained from the ponds would be transported downstream to the tidally-influenced reach of the river within a period of days.

Alternatives B and C included expanded mining with similar footprints, although Alternative B would involve mining over a smaller area in order to avoid existing wetlands and mature forest. Both alternatives included monitoring the rate of channel migration, and would require responses to an avulsion threat (CM-09, Contingency Plan). Monitoring under Alternative C would be limited to the term of the ITP, but Alternative B would likely result in monitoring in perpetuity (MEM-07, East Fork Lewis River Channel Bank Stability Monitoring), funded by the conservation measure CM-05 (Endowment). The preferred response to a threat of avulsion under Alternatives B and C would be bioengineered techniques. Engineered, structural, techniques would be implemented only under emergency conditions, and under Alternative B, there is the option of modifying or removing such engineered structures when mining is terminated and reclamation/restoration is nearly complete if deemed beneficial to habitat by the Services, WDFW, and LCFRB (see MEM-07).

Should the East Fork Lewis River avulse into the existing ponds, the short-term effects of fine-sediment release would be similar for each alternative, but the negative long-term effects would be reduced under the preferred alternative (Alternative B). Channel abandonment following an avulsion would result in a change in the quantity and quality of spawning and rearing habitat. The calculated changes in habitat area under the three most likely avulsion scenarios between RM 7 and RM 9 are shown in Figures 6-4, 6-5 and 6-6 and Table 6-5 in the HCP. Review of the figures and table indicate that, following an avulsion into the existing ponds, the area of spawning could be reduced (Path 1) or increased (Path 2 or 3), while the area for rearing would increase under all three scenarios. Under each of the alternatives, an avulsion along flow Path 1 would result in the loss of about 15,000 square yards (approximately 22%) of spawning (riffle) habitat between RM 7 and RM 9. In the short term following an avulsion, a head cut would generally develop upstream, and channel incision would occur downstream of the ponds. The low stream flow velocities through the ponds would result in more efficient trapping of both suspended and bed load materials with consequent coarsening of the bed, as well as undercutting and erosion of banks downstream. Once the former ponds fill with sediments to the approximately thalweg elevation of the former main channel (geomorphic recovery), sediment trapping would be reduced and the channel would function more closely to the natural, unavulsed condition. Geomorphic recovery in the event of an avulsion into the existing Daybreak ponds is estimated to take approximately 30 years under Alternatives A-1, A-2 and C. Alternative B (preferred alternative) includes significant infill and reconfiguration of the existing ponds. The infill would raise the bottom of Pond 1 to the approximate thalweg elevation of the East Fork Lewis River, reducing the potential for and possible extent of upstream headcutting. In addition, the narrowed configuration of the existing ponds would lessen the area and volume of the ponds, reducing the time for geomorphic recovery. Implementation of the preferred alternative would, therefore, result in a reduction in the extent, magnitude and severity of cumulative effects resulting from a potential avulsion into the existing ponds. This would consequently reduce the amount and severity of take that could occur as the result of an avulsion, compared to Alternatives A-1, A-2 and C.

Long-term cumulative effects to the covered species and their habitat would also differ depending on the final land use of the site. Alternatives A-1 (Rural Residential Outcome) and A-2 (Mining and Reclamation without HCP/ITP) would result in the development of building sites and construction of homes and out buildings comparable to those resulting from past and on-going development activities in the area. However, under these alternatives it is reasonable to expect that Storedahl would sell the partitioned parcels to maximize economic gain. As these parcels are partitioned, sold, and developed for rural residential use, the transaction costs and institutional difficulties of including the entirety, or even a majority, of the site in the East Fork Lewis River greenbelt increases. The ability to include the entire 300-acre site in the greenbelt would become impracticable if not impossible. Increased public and private infrastructure and other property development could result in the implementation of increased flood, erosion and avulsion protection and prevention measures along this reach of the East Fork Lewis River (see FEMA comment letter FED 4). These outcomes in the cumulative and long-term perspective are likely to result in more adverse impacts to fish and wildlife habitat and populations than the preferred alternative.

Alternatives B (Preferred Action) and C (July 2000 Draft HCP) would result in the creation of open water, wetlands and native valley-bottom forest where pasture and cultivated fields now exist. At the completion of the mining and habitat enhancement, the property would be transferred to one or more conservation groups, with a conservation easement, to remain in open space to benefit fish and wildlife habitat in perpetuity, and FEMA supports the "preferred alternative due to the beneficial impacts it provides to the floodplain functions of the East Fork Lewis River and its avoidance of placing (potentially) insurable structures in harms way" (FEMA comment letter FED 4). The cumulative effect of these alternatives would be the addition of 300 acres (approximately 20%) to the greenbelt along the East Fork Lewis River at no cost to the general public or non-profit conservation organizations. Alternative B also includes several conservation measures that are not part of Alternative C. Notably, Alternative B avoids several wetlands along the margin of the property, preserves several stands of mature conifers, gifts existing water rights to the State Trust for instream flow enhancement, fills and reconfigures the existing ponds for avulsion readiness, provides services and materials for off-site floodplain enhancement, and insures the monitoring and management of the property in perpetuity through an endowment to pass with the fee simple transfer of the property. In addition, Alternative B includes posting of a bond to cover avulsion contingency upon initiation of the ITP, and to ensure that funds are available for appropriate responses to an avulsion threat, should it develop.

In summary, the Services have considered the cumulative effects of each of the conservation measures with respect to each of the environmental elements analyzed, but focused on the existing, baseline conditions and the long-term cumulative effects of the project on the East Fork Lewis River and the species proposed for coverage. The Services believe the benefits with respect to long-term cumulative effects of implementing the preferred alternative are significant compared to the other alternatives.

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GLOSSARY

afy. Acre feet per year. Volume per unit time, i.e., 1-foot of depth over an area of 1-acre per year.

Advective. Transported by flowing water in response to a hydraulic gradient.

Alevin. A pre-emergent salmonid incubating in gravel substrate.

Alluvial. Pertaining to alluvium, used as a term for recent unconsolidated sediments.

Aquifer. A geologic formation, group of formations, or part of a formation that contains sufficient saturated material to yield economical quantities of groundwater to wells or springs.

Alluvial fan. A fan-shaped deposit of sediment built by a stream where it emerges from an upland or a mountain range into a flatter valley or plain.

Anadromous. Moving from the sea into fresh water to spawn, as in salmon and some trout.

Avulsion. A sudden and unexpected shift in the location of a river channel resulting in the abandonment of the old channel.

Avulsion sills. Structures constructed of large rock or other non-erodible material placed to prevent downcutting and shifting of a river channel.

Backwater. Water backed up or retarded in its course as compared with its normal or natural condition of flow. Ineffective backwater refers to areas that lack erosive current.

Bankfull stage. The water surface elevation attained by a stream when flowing at capacity, i.e., stage above which banks are overflowed.

Barbs. A rock structure placed in a river near the toe of a bank that is angled upstream to reduce flow velocities near the bank.

Baseflow recharge. The discharge entering stream or river channels from groundwater or other delayed sources.

Benthic. Includes all of the bottom terrain from the shoreline to the greatest depths of water bodies such as ponds, as in **benthic sediments**.

Best management practices. Physical, structural, and/or managerial practices approved by Ecology that, when used singularly or in combination, prevent or reduce pollutant discharges.

Bioassay. Determination of the strength or biological toxicity of a substance by comparing its effects with those of a standard preparation on a test organism.

Braided channels. Flowing in several dividing and reuniting channels resembling the strands of a braid, the cause of division being the obstruction by sediment deposited by the stream.

ºC. Degrees Celsius.

cfs. Volume per unit time, i.e., cubic feet per second.

Channel Migration Zone. **T**he land area that the river channel has occupied in the last few years or decades and would reasonably be expected to occupy again in the near future.

Climax ecosystem. The last stage in ecological succession. An ecosystem in which populations of all organisms are in balance with each other and with existing abiotic factors in a state of dynamic equilibrium.

Closed-loop clarification system. A chemical/mechanical system designed to clarify process washwater and recirculate it to the processing unit for reuse, as in **Closed-loop water treatment** and **Closed-loop recirculating washwater clarifier**.

Coagulant. A substance used to neutralize the negative charge on particles and destabilize a suspension.

Colloidal suspension. A suspension of finely divided particles in a continuous medium in which the particles do not settle out of the substance rapidly, and are not readily filtered.

Conservation easement. A legal arrangement whereby a landowner gives up specified development rights into the future, but retains ownership of the land.

dBA. An abbreviation for A-weighted decibels, which are sound pressure levels in decibels measured using the "A" weighting network on a sound level meter.

Debris jams. Collections of large woody debris that intercept channel flows.

Denitrification. The process by which microorganisms convert nitrates and nitrites to free nitrogen.

Distinct Population Segment "Population" or "distinct population segment" are terms with specific meaning under ESA when used for listing, delisting, and reclassification purposes to describe a discrete vertebrate stock that may be added or deleted from the list of threatened and endangered species.

Diaphragm fences. Structures placed to divert and absorb sound.

Drop structures. Solid cross channel weirs that concentrate flow near the center of a channel and dissipates potential energy.

Emergent wetlands. Area of vegetated wetland where non-woody vegetation comprises at least 30% of the areal cover.

Ephemeral streams. Streams that flow only in direct response to precipitation and normally are dry for long periods of time such as the summer season.

Evapotranspiration. The process by which water is evaporated from surface water and the soil, and transpired from plants. Forms a key component of the hydrologic cycle.

Evolutionary Significant Unit (ESU) - A population or group of populations of salmon that 1) is substantially reproductively isolated from other populations and 2) contributes substantially to the evolutionary legacy of the biological species. (This concept is used by NMFS in its administration of the ESA for anadromous salmon populations.)

Fecal coliform. A bacterium that normally inhabits the gut of humans and other warm blooded mammals.

Fines. Consisting of silt and clay.

Flocculant. A substance that induces or promotes the aggregation of fine grained materials into larger particles, thereby increasing their mass and, consequently, rate of settling in water.

Floodplain. That portion of a river valley, adjacent to the river channel, which is built of **Fluvial sediments**. **Geomorphic floodplain** refers to the floodplain created over geologic time. **Hydrologic floodplain** refers to the land adjacent to the baseflow channel and below bankfull stage, that is inundated about two years out of three.

100-year floodplain. Those areas of the river valley that are inundated by a flood that has on average a 1 percent chance of occurring in any given year. Those areas identified as Zones A, A1-30, AE, AH, AO, A99, V, V1-30 and VE on the effective Federal Emergency Management Agency Flood Rate Insurance Maps. Also referred to as the **Regulated floodplain**.

Fluvial sediments. Sediments transported or deposited by the action of flowing water.

Food web. The combination of all the feeding relationships that exist in an ecosystem.

Forested wetlands. Area of vegetated wetland where woody vegetation over 20 feet tall comprises at least 30% of the areal cover.

Fugitive dust. Uncontrolled fine particles in the air, generally resulting from processing or transport of rock products at aggregate mining and processing facilities.

Fuse plugs. A portion of a levee constructed of easily erodible material and designed to be overtopped and eroded away when a specific flood stage is exceeded. It will act as a spillway to direct flood water in a controlled fashion to a specific location.

Geomorphology. The study of the evolution of landforms.

gpd. Volume per unit time, i.e., gallons per day.

Groins. Hydraulic structures placed along channel banks to redirect the course of flow, dissipate energy and reduce velocities in proximity to the channel bank, and control bank erosion.

Groundwater. Water in a saturated zone or stratum beneath the surface of land or below a surface water body.

Groundwater flow systems. A conceptual model describing the flow or movement of groundwater from its primary recharge to its discharge areas, based on hydrogeology. Regional groundwater flow systems typically extend for many miles, while local groundwater flow systems are smaller, e.g. recharge and discharge areas are 100s to 1000s of feet apart.

Heisson gage. The U.S. Geological Survey river gage located at river mile 20.2 about 1.5 miles northeast of Heisson, Washington.

Holocene. The most recent geologic epoch extending from the older Pleistocene epoch in the Quaternary Period to the present, i.e., the past 10,000 years, also referred to as Recent.

Hydrogeology. The study of subsurface waters and related geologic aspects of surface waters.

Hypogean. Below the surface of the earth, living underground. Applied to cave-restricted fishes.

Hyporheic zone. An area adjacent to and below channels where groundwater is exchanged with channel water in bi-directional flow, and movement is mainly in the downstream direction.

Hyporeos. Fauna in the hyporheic zone, which are often distinguished by life history characteristics or adaptations to life within sediment interstices.

Ineffective Backwater. Areas of water that lack erosive current.

Intermediate flow systems. Groundwater movement intermediate to, i.e., between the scale of **Local and Regional flow systems**.

Intermittent streams. Streams or portions of streams which exhibit surface flow only part of the time, e.g., during the wet season.

Interstitial. Pertaining to the volume or material within pore space in rocks and sediments, e.g. petroleum and groundwater.

Lake Missoula outburst floods. Catastrophic floods during the Pleistocene epoch resulting from the breaching of an ice dam, which formed glacial Lake Missoula, in northern Idaho and northwestern Montana. The ice dam reached a maximum height of several thousand feet above the valley floor and when the dam broke, as much as 50 cubic miles of water rushed over the Columbia Plateau and subsequently down the Columbia River.

Lateral migration rate. The rate at which a river channel moves laterally across the floodplain.

Lateral tributaries. Tributary streams that join a mainstem channel.

Levees. Broad low embankments built up along the banks of a river channel as a result of natural sediment deposition. Also refers to constructed dikes placed for flood control purposes.

Lithology. The study of the physical characteristics of a rock.

Mainstem. The primary or main channel of a river.

Makeup water. The volume of water withdrawn routinely to augment flow through the closed-loop treatment system.

Mitigated hazard zone. The portion of the floodplain excluded from the **Channel migration zone** due to the presence of infrastructure such as permanent roads, developed areas, revetments and levees.

Monoculture. The practice of growing a single crop over a large area.

Nitrification. The breakdown of nitrogen-containing organic compounds by microorganisms into nitrites and nitrates.

NPDES National Pollutant Discharge Elimination System. The Federal Water Pollution Control Act (The Clean Water Act) establishes a National Pollution Discharge Elimination System (NPDES) permitting program (40 CFR § 122 through 125), delegated to the State of Washington, that establishes discharge limits and monitoring requirements for stormwater discharges from several groups of industries and certain municipalities. In compliance with the provisions of the State of Washington Water Pollution Control Law (Chapter 90.48 Revised Code of Washington), the Washington Department of Ecology (Ecology) grants general permits for process water, stormwater, and mine dewatering water discharges associated with sand and gravel operations, rock quarries, and similar mining facilities, including stockpiles of mined materials, concrete batch operations and hot mix asphalt operation.

Overburden material. Earth, rock, soil, and topsoil that lie above mineral deposits.

Overtopping erosion protection. Materials such as rock, asphalt, and concrete used to resist hydraulic forces associated with overtopping flow, protect underlying erodible materials, and prevent erosion.

Perched groundwater. Groundwater that is not in a direct hydraulic connection with the local water table.

Perennial streams. Steams that flow year-round.

Periglacial deposits. Refers to areas, conditions, processes, and deposits adjacent to the margin of a glacier.

Photosynthesis. The production of complex organic materials, especially carbohydrates, from carbon dioxide, water, and inorganic salts, using sunlight as the energy source and aided by chlorophyll and associated pigments.

Piezometer. A small diameter well that allows the measurement of head or hydrostatic pressure at a given point in the saturated zone.

Planform analysis. Changes in the location of the river channel over time.

Pleistocene. A geologic epoch lasting from approximately 2 million to 10,000 years ago.

Porosity. The percentage of the bulk volume that is occupied by interstices (voids), whether isolated or connected. **Effective porosity** is the volume of void space that conducts most of the fluid flow divided by the total volume of the soil.

Porous weirs. A low-profile hydraulic structure constructed of loosely consolidated boulders that spans the entire channel, thereby facilitating energy dissipation and reducing bank erosion.

Profile analysis. A study of the changes in the slope of the river channel over a selected distance.

Redd. A nest in the stream bed that salmon build to lay eggs.

Riparian. An area between aquatic and terrestrial ecosystems defined by the presence of vegetation that requires moist conditions and, usually, periodic free flowing water.

Riprap. A quantity of broken stone for foundations, revetments or embankments.

Rock revetment or rock toe. A structural feature used for erosion protection along river banks.

Salmonids. Fish belonging to the family Salmonoidea, which includes salmon, trout, char and whitefish.

Secondary channels. Split flow paths from the mainstem channel, with active channel characteristics, that typically convey significant flow only during annual high runoff. During the remainder of the year they may be dry or convey primarily groundwater or seepage from the adjacent watercourse. Often they are former mainstem channels abandoned through lateral migration or avulsion.

Setback levee. A levee set back from the channel to allow some overbank flooding.

Sight distance. The distance that one can see oncoming traffic from an intersection.

Solute. Dissolved organic or inorganic substances in a solvent, such as water.

Species of concern. An informal term that refers to those species that might be in need of concentrated conservation actions. Such conservation actions vary depending on the health of the populations and degree and types of threats. At one extreme, there may only need to be periodic monitoring of populations and threats to the species and its habitat. At the other extreme, a species may need to be listed as a Federal threatened or endangered species. Species of concern receive no legal protection and the use of the term does not necessarily mean that the species will eventually be proposed for listing as a threatened or endangered species.

Specific capacity. Discharge per unit drawdown in a water well, commonly expressed in gallons per minute per foot of drawdown.

Stormwater runoff. That portion of precipitation that does not naturally percolate into the ground or evaporate, but flows via overland flow, interflow, channels, or pipes, into a defined surface water channel or a constructed infiltration facility.

Stratification. A geologic structure produced by deposition of sediments in beds or layers, lenses, wedges, and other essentially tabular units.

Stratigraphy. Features of geology dealing with the origin, composition, distribution, and succession of geologic strata (layers).

Sub-climax. A stage of succession prior to climax. Periodic disturbance can maintain a sub-climax ecosystem.

Succession. The directional, cumulative change in a species that occupy a given area, over time.

Thornwaite-Mather method. A mathematical model used to calculate evaporative losses, incorporating soil moisture holding capacity, precipitation and temperature data.

Troutdale formation. A regional geologic/hydrogeologic unit in the Portland basin.

Turbidity. Condition of reduced light transfer and/or visibility in water due to the presence of suspended solids or organic matter.

Unconsolidated sedimentary rock aquifer. A regional geologic/hydrogeologic unit in the Portland basin.

Upland. Any area that does not qualify as wetland because the associated hydrologic regime is not sufficiently wet to elicit development of vegetation, soils, and/or hydrologic characteristics associated with wetlands.

Water rights. A permit issued by the Washington Department of Ecology to withdraw a specified amount of ground or surface water for beneficial use.

Water table. The surface of a body of unconfined groundwater at which the pressure is equal to that of the atmosphere**.**

Wet processing. The use of water to process aggregate into rock products, including the separation of clay, silt, sand and gravel and the washing of aggregate and crushed rock to remove fine-grained material.

Willamette-Puget lowlands. The physiographic province extending from the Klamath Mountains in the south to British Columbia and including the valley of the Willamette River, parts of the valleys of the Cowlitz and Centralia Rivers and the interior lowland of Puget Sound, also commonly referred to as the Puget-Willamette Trough.

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